



15<sup>TH</sup> CONFERENCE OF THE INTERNATIONAL  
SOCIETY OF INDOOR AIR QUALITY & CLIMATE

# INDOOR AIR 2018

July 22 - 27, 2018 | Philadelphia, PA, USA

## Conference Program



INDOOR AIR 2018 is the Flagship Conference  
of the International Society for Indoor Air  
Quality and Climate (ISIAQ)



Hosted by Drexel University

# Table of Contents

- Welcome Messages ..... 1
- Sponsors ..... 4
- Exhibitors..... 6
- Conference Organization..... 8
  - Conference Leadership..... 8
  - Technical Track Leads..... 8
  - International Scientific Advisory Committee ..... 10
  - Session Chairs ..... 14
- ISIAQ Information ..... 15
- Conference Information..... 16
  - Guide for Presenters ..... 20
  - Guide for Session Chairs ..... 22
- Maps and Directions..... 23
- Opening Ceremony and Weekend Events at Drexel University..... 29
  - ISIAQ Summer School ..... 29
  - ISIAQ Business Meetings ..... 29
  - Opening Registration..... 29
  - Opening Ceremony..... 29
- Social Events..... 30
  - Student Party – Monday night..... 30
  - Chair Dinner – Tuesday night ..... 30
  - Indoor Air Goes Outside – Wednesday evening ..... 30
  - Conference Party – Thursday night..... 30
- Technical Program Overview ..... 31
  - Monday, July 23<sup>rd</sup> ..... 31
  - Tuesday, July 24<sup>th</sup> ..... 32
  - Wednesday, July 25<sup>th</sup> ..... 33
  - Thursday, July 26<sup>th</sup> ..... 34
  - Friday, July 27<sup>th</sup> ..... 35
- Plenary Speakers..... 36
  - Monday, July 23<sup>rd</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A) ..... 36
  - Tuesday, July 24<sup>th</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A)..... 37
  - Wednesday, July 25<sup>th</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A) ..... 38
  - Thursday, July 26<sup>th</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A)..... 39
  - Friday, July 27<sup>th</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A)..... 40
  - Friday, July 27<sup>th</sup> – Closing Plenary (15:30 – 16:00 Ballroom A)..... 41
- Special Sessions ..... 42
  - Symposia ..... 42
  - Workshops ..... 52
  - Other Special Sessions..... 55
- Detailed Technical Program..... 56
  - Monday, July 23<sup>rd</sup> ..... 56
    - Morning Podium Sessions – 200 level rooms (10:30 – 12:00) ..... 56
    - Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)..... 61
    - Afternoon Poster Sessions – Ballroom B (15:30 – 17:30) ..... 65
  - Tuesday, July 24<sup>th</sup> ..... 70
    - Morning Podium Sessions – 200 level rooms (10:30 – 12:00) ..... 70

---

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00).....	75
Afternoon Poster Sessions – Ballroom B (15:30 – 17:30) .....	80
Wednesday, July 25 <sup>th</sup> .....	86
Morning Podium Sessions – 200 level rooms (10:30 – 12:00) .....	86
Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00).....	91
Thursday, July 26 <sup>th</sup> .....	96
Morning Podium Sessions – 200 level rooms (10:30 – 12:00) .....	96
Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00).....	101
Afternoon Poster Sessions – Ballroom B (15:30 – 17:30) .....	105
Friday, July 27 <sup>th</sup> .....	110
Morning Podium Sessions – 200 level rooms (10:30 – 12:00) .....	110
Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00).....	114

## Welcome Messages

### Welcome from INDOOR AIR 2018 Conference President

Dear INDOOR AIR 2018 participants,

I would like to welcome you, our friends and colleagues, to INDOOR AIR 2018, the 15<sup>th</sup> Conference of the International Society of Indoor Air Quality & Climate (ISIAQ), held in Philadelphia, Pennsylvania from July 22 to 27, 2018, hosted by Drexel University.

The purpose of the INDOOR AIR conferences is to present and exchange research ideas on important, state-of-the-art topics related to indoor air pollution, healthy and productive indoor environments, and associated building energy consumption. These conferences routinely attract hundreds to thousands of researchers and practitioners from all over the world. Knowing this, from the outset, we organizers decided that having an excellent technical program was of the utmost importance for hosting a successful conference. To this end, we have assembled distinguished plenary speakers who are truly outstanding leaders in their respective areas. We also have a robust podium and poster program and *Proceedings*, thanks to your excellent contributions. We hope that you leave the conference more curious, having learned much, and with expanded viewpoints.

The INDOOR AIR conferences are also about fun and comradery. For many of us, these conferences afford the only time we see each other over the course of a year or two. Keeping this spirit, we have also tried to put together a fun and interesting social program, including an opening reception at Drexel, a student bowling party, a chair dinner at the world's oldest and largest square rigged sailing vessel still afloat, an outdoor day with roller skating and mini-golf, and a conference party at a renowned natural history museum! In addition, we encourage you to take advantage of Philadelphia's historic areas, including our many world-class museums and cultural heritage sites that were the birthplace of the modern United States of America.

Finally, as President, I want to thank all those that have helped get to this point of actually hosting the conference, which is so far from where we started. Foremost, thanks to Brent Stephens, the Technical Chair, who worked alongside me tirelessly with complete dedication to ensure this effort was a success. I could never thank him enough. Also, thanks to Bill Nazaroff, our Advisory Chair, who kept us on task and illuminated important details, and James Lo, our Content Management Chair, who guaranteed that everyone was able to contribute to the technical program effectively. I also thank Kim Spina from Drexel for her cheerful support, and our lead Drexel student organizers, Yun "Emma" Zhang, Chunyi Wang, Bryan Cummings, Prateek Pant, Mihai Burlacu, and Tom Ben-David. "Yo, Adrian, we did it!"

And, of course, we couldn't have this conference with all of you, our indoor air community. Thanks for traveling to Philadelphia to attend INDOOR AIR 2018, and thanks to our sponsors for their support. We organizers are pleased and excited to host the flagship conference of ISIAQ, and we truly wish that you have an intellectually stimulating and enjoyable experience!

Sincerely,  
Michael Waring  
Conference President  
Drexel University

## Welcome from the President of ISIAQ

Dear participants of INDOOR AIR 2018,

Welcome to Philadelphia, a city steeped in American history as the nation's capital between 1790-1800, and of course famous for signing the Declaration of Independence, and Rocky Balboa.

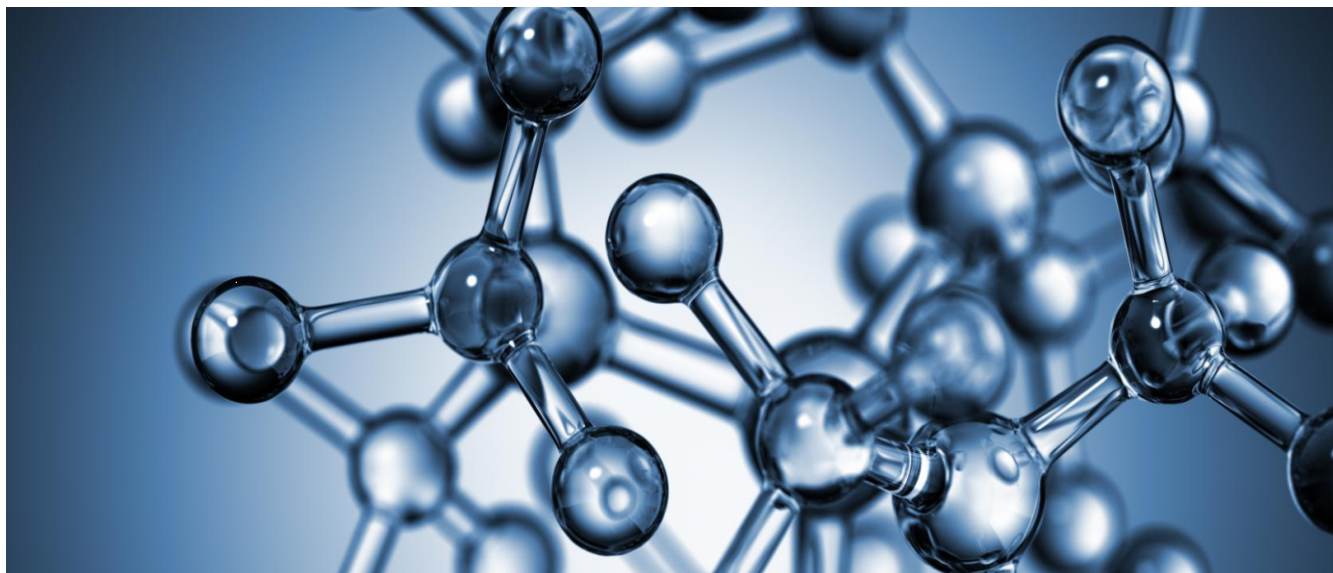
As President of the International Society of Indoor Air Quality and Climate (ISIAQ), I am looking forward to meeting you in this special place. Of course I am especially grateful to the organizers: Michael Waring, Brent Stephens, and William Nazaroff for taking the lead in the organization of this Indoor Air conference. They were supported by many other volunteers. We rely on voluntary engagement, and we are lucky that we have many that support us in this endeavour! I can only be grateful for that.

INDOOR AIR 2018 is the follow-up of the INDOOR AIR 2016 conference that was held in Ghent. The Indoor Air conferences are the flagship conferences of ISIAQ, supported by the Academy of Fellows. Indoor Air tries to bring together scientists and all those interested in the topic of indoor air quality and climate from around the world, exchanging latest research findings in the field. Indoor Air alternates with the regional Healthy Buildings (HB) conferences that take place in uneven years. This latter type of conference is a bit a more practice oriented.

ISIAQ is a multidisciplinary organization that supports cooperation by exchanging knowledge and expertise within and between different disciplines. In a developing world that more and more acknowledges the importance of health in the built environment, ISIAQ takes an important and independent position. And, of course, we are proud of that. Nevertheless, we also should be open to communicate the important results, not only to our colleague-researchers, but also to the general public! I invite you not to be too modest about your work, it is important!

I wish you all an inspiring week in 'Philly' and hope you will travel home with new knowledge, new ideas, inspiration, and new contacts that allow you to continue and develop your work further. If you are interested in getting more involved in ISIAQ to support its mission or in sharing your expertise with students or a broader public, please have a look at our new website ([www.isiaq.org](http://www.isiaq.org)) and contact us! And, of course, we invite you to come to our next year's regional conferences, in China or Lithuania (the latter being co-sponsored with ISES), to present your new research results there.

Sincerely,  
Marcel Loomans  
ISIAQ President (2016-2018)



The Alfred P. Sloan Foundation is proud to support INDOOR AIR 2018 by supporting symposia, travel grants, and a plenary involving two of their scientific programs:

**Chemistry of Indoor Environments (CIE)**

The goal of the Sloan CIE program is to grow a new field of scientific inquiry focused on understanding the fundamental chemistry taking place in indoor environments and how that chemistry is shaped by building attributes and human occupancy.

**Microbiology of the Built Environment (MoBE)**

The goal of the Sloan MoBE program has been to grow a new multidisciplinary field of scientific inquiry focused on understanding the microbial ecology of the built environments where people work, live, and play.



ALFRED P. SLOAN  
FOUNDATION

## Sponsors

### Alfred P. Sloan Foundation

The Alfred P. Sloan Foundation has provided generous support for INDOOR AIR activities in the fields of Chemistry of the Indoor Environment (CIE) and Microbiology of the Built Environment (MoBE).

#### Chemistry of the Indoor Environment (CIE)

In addition to the plenary talk by Allen Goldstein, titled *Bringing Atmospheric Chemistry Home*, the Sloan Foundation is sponsoring these conference symposia featuring work from their CIE program:

- **What are the impacts of humans and their activities on indoor chemistry?**
- **MOCCIE: first results from a new modelling consortium for indoor air chemistry**
- **Frontiers in indoor air chemistry**

#### Microbiology of the Built Environment (MoBE)

The Sloan Foundation is also sponsoring the following conference symposia featuring work sponsored by their MoBE program:

- **Improving practical microbial assessments for studying occupant health and investigating building health**
- **Water on surfaces and dust: Implications for indoor chemistry and microbiology**

The Sloan Foundation's MoBE program also provided generous support of up to \$1,500 each for early career scientists (including graduate students, postdoctoral fellows, and Assistant Professors) who submitted Extended Abstracts or Full Papers to cover registration, accommodation, and/or travel expenses to INDOOR AIR 2018. Funding was awarded to the following individuals:

- Ashleigh Bope, Ohio State University (Paper 401)
- Cesar Cardona, The University of Chicago (Papers 628 and 749)
- Jinglin Hu, Northwestern University (Paper 333)
- Aaron Prussin II, Virginia Tech (Papers 124 and 235)
- Yilin Tian, University of California, Berkeley (Papers 385, 397, 406, 659, 676, 678, 681)
- Maria Valkonen, National Institute for Health and Welfare (Paper 541)

### Other Sponsors

We thank three other sponsors of INDOOR AIR 2018, including:

- **Drexel University (Silver level)**
- **Gerstel (Supporting level, also an Exhibitor)**
- **Daikin (Supporting level)**



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For over 90 years, we've worked to realize a better environment and quality of life through providing heating and cooling solutions. Today, our new Daikin Texas Technology Park (DTTP), located just outside of Houston, Texas, consolidates our manufacturing, engineering, logistics, marketing, and sales departments in one location. The U.S. Green Building Council awarded the DTTP, Leadership in Energy and Environmental Design (LEED®) Gold certification for our office interiors. To learn more, visit [www.northamerica-daikin.com](http://www.northamerica-daikin.com)



## Exhibitors

We appreciate the engagement of the following Exhibitors, who will have staff working their booths and displays in Ballroom B in the Convention Center from Monday through Thursday:

### 2B Technologies

2B Technologies is dedicated to the development and commercialization of new analytical instruments for atmospheric, indoor and environmental measurements. We specialize in miniaturized instruments for measurements of ozone (O<sub>3</sub>), nitric oxide (NO), nitrogen dioxide (NO<sub>2</sub>), mercury (Hg; under development), and other chemical species in air.

### Aerosol Devices Inc.

Do you believe in Magic? Stop by to see the new MAGIC™ CPC – a compact, tippable, water-based Condensation Particle Counter for measuring number concentration of ultrafine particles. We are also featuring the Spot Sampler™ aerosol particle collector for time-resolved sampling for physical, chemical and biological analysis.

### Aethlabs

AethLabs manufactures the microAeth® family of Black Carbon (BC) monitors. The new microAeth MA Series are battery powered, self-contained, multi-wavelength instruments with automatic filter tape advance for long duration BC measurements. The instruments feature DualSpot® technology and are based on proven Aethalometer® measurement technology used world-wide for over 35 years.

### Airmodus

Airmodus offers Particle Size Magnifier systems that are able to detect both neutral and charged particles down to 1 nm in diameter, filling the gap between traditional aerosol particle size distribution measurements and gas phase monitoring; and easy-to-use Condensation Particle Counters with a cut-off size fit for your measurement needs.

### Airthinx

Airthinx IAQ offers an affordable and scalable solution for continuous, accurate and precise monitoring of air quality at room-level. Each 3G, wireless, cloud-connected device collects data in real-time utilizing 9 built-in sensors: PM<sub>1</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>, CO<sub>2</sub>, CH<sub>2</sub>O, VOCs, temperature, humidity and pressure with secure access to the data via the app or web.

### Gasera

Gasera is a Finnish company that develops and manufactures Photoacoustic gas analyzers. Products include a laser based analyzer for Formaldehyde with sub ppb detection limit and NDIR units for investigating air exchange rates, IAQ and Photocatalysis performance.

### Gerstel Inc.

50+ Years of Chemical Analysis Solutions! GERSTEL analytical instrumentation have enabled analysts to achieve ultra-low detection levels in complex matrices with unequalled preparative capability, while dramatically increasing sample throughput; handle difficult sample preparation challenges; and analyze wide ranges of sample types complete with software integration (Agilent Technologies, SCIEX, LECO, ThermoFisher, Shimadzu).

### GrayWolf

GrayWolf manufactures cutting-edge portable IAQ test instrumentation and enhanced software. Broad range of sensors including TVOC, CO<sub>2</sub>, CO, O<sub>3</sub>, HCHO, ΔP, PM10 and more. Efficient report generation for LEED 3.2, IAQ, IH, FM, and other applications. Cloud based remote access to instrument data with GrayWolfLive™.

## Kanomax

Kanomax USA, Inc. specializes in supplying devices mainly for measuring air flow at quality indoor air with the diversity of indoor environments. Our parent company, KANOMAX, headquartered in Japan and founded in 1934, strives to deliver the best possible solutions for detecting particles and measuring air flow.

## Particles Plus

Particles Plus, Inc. manufactures high quality, professional grade particle counters and air quality monitors for the life science, indoor air quality, and industrial hygiene industries. Their many industry-first features were designed with indoor air quality investigators and remediation professionals in mind. For pricing, technical questions or a quote, call today!

## TSI

TSI Incorporated is the industry leader in accurate, intuitive real-time instrumentation. Indoor air quality is a growing concern for building owners, facility managers and industrial hygienists focused on comfort and health. TSI offers a line of hand-held IAQ instrumentation, measuring CO<sub>2</sub>, VOC's and dust particles.

## US EPA

The U.S. Environmental Protection Agency, Indoor Environments Division (IED) implements a non-regulatory program to improve indoor air quality in homes, schools, and commercial buildings. IED provides guidance and technical assistance on indoor air quality issues including: mold, radon, particulate matter, environmental tobacco smoke, volatile organic compounds, and indoor asthma triggers.

## US Nuclear Corp.

RANDFAN-SX Radon Switch controls the automatic, real time, radon mitigation system. Ideal for buildings, businesses and residential properties. Existing radon fans run 24/7 and waste money but still may not protect your staff, customers, tenants and public from cancer-causing radon, the world's 2<sup>nd</sup> largest cause of deadly lung cancer.

## WellAir

WellAir provides an ecosystem for healthy air that integrates whole-building HVAC air purification, in-room portable air disinfection, air quality sensors and customizable software. WellAir products are trusted to protect occupant health and optimize productivity in hundreds of hospitals, schools, senior living facilities, and other commercial buildings worldwide. Learn more at [www.wellair.ie](http://www.wellair.ie).

## Conference Organization

### Conference Leadership

Role	Name	Affiliation
Conference President	Michael Waring	Drexel University
Technical Program Chair	Brent Stephens	Illinois Institute of Technology
Advisory Chair	Bill Nazaroff	University of California, Berkeley
Content Management Chair	James Lo	Drexel University
Content Management Student Organizer	Yun “Emma” Zhang	Drexel University
Volunteer Student Organizer	Chunyi Wang	Drexel University
Summer School Student Organizers	Chunyi Wang	Drexel University
	Prateek Pant	Drexel University
	Bryan Cummings	Drexel University
	Tom Ben-David	Drexel University (graduated)
Website Developer	Mihai Burlacu	Drexel University
Administrative Support	Kim Spina	Drexel University
Logo Design	Akram Ali	Illinois Institute of Technology

### Technical Track Leads

Conference submissions were categorized into 10 thematic areas, or Technical Tracks, each with a designated Technical Track to help the Conference Leadership team manage reviews of Extended Abstracts. We are grateful for the 10 Technical Track Leads and those who helped them, listed below.

Technical Track	Name	Affiliation
Air Cleaning and Filtration	Jeffrey Siegel*	University of Toronto
Building Simulation and CFD	James Lo	Drexel University
Chemistry and Transformations	Ray Wells	NIOSH
Comfort, Productivity, and Perception	Pawel Wargocki	DTU
Concentrations and Exposure	Andrea Ferro**	Clarkson University
Energy, Climate Change, and Policy	Ellison Carter	Colorado State University
Health Effects and Epidemiology	Jill Baumgartner	McGill University
Microbiology and Dampness	Tiina Reponen	University of Cincinnati
Sources and Emissions	Tunga Salthammer	Fraunhofer, WKI
Ventilation and HVAC Systems	Andrew Persily	NIST

\*With additional help from Raheleh Givehchi, University of Toronto

\*\*With additional help from Phil Hopke, University of Rochester

## Student and Staff Volunteers

Student and staff volunteers from Drexel University, Illinois Institute of Technology, and University of Pennsylvania will be working diligently throughout the week to help make the conference run smoothly. Feel free to ask them any questions as needed. They will be running the speaker ready room, addressing technical problems, helping with setting up posters, and more.

Name	Affiliation
Chunyi Wang	
Yanan Yang	
Bryan Cumming	
Yun "Emma" Zhang	
Prateek Pant	
Sheng Wang	
Erin Katz	Drexel University
Congmeng Lyu	
Laura Ampollini	
Bryan Berman	
Anita Avery	
Ben Werden	
Jason Callaghan	
Gabriel Grajewski	
Jewlianna Moore	University of Pennsylvania
Parham Azimi	
Torkan Fazli	
Haoran Zhao	
Dan Zhao	Illinois Institute of Technology
Akram Ali	
Afshin Faramarzi	
Brett Horin	

## International Scientific Advisory Committee

We are grateful for those who contributed as part of the International Scientific Advisory Committee, conducting Full Paper reviews to help maintain a high quality and relevance of submissions, actively promoting the conference, and contributing to the work of various panels, workshops, and/or symposia.

Name	Affiliation
Akram Ali	Illinois Institute of Technology
Alessia Di Gilio	University of Bari
Alexandra Schieweck	Fraunhofer WKI
Alireza Afshari	Aalborg University
Amy Li	University of Toronto
Aneta Wierzbicka	Lund University, Sweden
Atze Boerstra	BBA IEQ consultancy
Ayoko Godwin	Queensland University of Technology
Benjamin Hanoune	University of Lille
Bin Cao	Tsinghua University
Bin Zhao	Tsinghua University
Birte Mull	Fraunhofer WKI
Brandon Boor	Purdue University
Brett Green	NIOSH
Brett Singer	Lawrence Berkeley National Laboratory
Bryan Cummings	Drexel University
Carla Viegas	Lisbon School of Public Health
Catherine Noakes	University of Leeds
Chandra Sekhar	Natl U of Singapore
Chao Tan	University of Waterloo
Chao-Hsin Lin	Boeing
Charles Weschler	Rutgers/DTU
Charles Haas	Drexel University
Cheng-Xian (Charlie) Lin	Florida International University
Cheol Jeong	University of Toronto
Christian Scherer	Fraunhofer IBP
Christopher Y. H. Chao	Hong Kong University of Science and Technology
Chun Chen	Chinese University of Hong Kong
Chungyoon Chun	Yonsei University
Coralie Schoemaeker	University of Lille
Corinne Mandin	CSTB
Dan Zhao	Illinois Institute of Technology
David Wyon	Technical University of Denmark
Derek Price	University of Colorado
Dick Heederick	University of Utrecht
Dong Hwa Kang	University of Seoul
Donghyun Rim	Penn State University
Dustin Poppendieck	NIST

Name	Affiliation
Eliot Horner	UL
Elliott Gall	Portland State University
Emma Zhang	Drexel University
Erik Uhde	Fraunhofer WKI
Francois Maupetit	CSTB
Gabriel Bekö	Technical University of Denmark
Gianluigi de Gennaro	University of Bari
Glenn Morrison	University of North Carolina
GN Bae	Korea Institute of Science and Technology
Guofeng Shen	US EPA
Hai Guo	Hong Kong Polytechnic University
Hal Levin	Building Ecology
Haoran Zhao	Illinois Institute of Technology
Heidi Salonen	Aalto University
Henrik Knudsen	Aalborg University
Iain Walker	Lawrence Berkeley National Laboratory
Jakob Kolarik	Technical University of Denmark
James Lo	Drexel University
Jan Kaczmarczyk	Silesian University of Technology
Jared Langevin	Lawrence Berkeley National Laboratory
Jason Ham	NIOSH
Jelle Laverge	University of Ghent
Jerzy Sowa	Warsaw University of Technology
Jianping Cao	Virginia Polytechnic Institute and State University
Jinhan Mo	Tsinghua University
Jolanda Palmisani	University of Bari
Joon-Ho Choi	University of Southern California
Jordan Clark	Ohio State University
Josephine Lau	University of Nebraska
Ju-Hyeong Park	NIOSH
Junjie Liu	Tianjin University
Karen Dannemiller	Ohio State University
Kathleen Owen	Consultant
Kati Huttunen	University of Eastern Finland
Kazukiyo Kumagai	California Department of Public Health
Kwok Wai Tham	National University of Singapore
Lance Wallace	Retired
Lars Gunnarsen	Aalborg University
Laura Kolb	US EPA
Lei Fang	Technical University of Denmark
Li Lan	Shanghai Jiao Tong University
Li Liu	Aalborg University
Liangzhu (Leon) Wang	Concordia University
Lidia Casas	University of Leuven

Name	Affiliation
Lidia Morawska	Queensland University of Technology
Linsey Marr	Virginia Tech
Lisa Ng	NIST
Lupita Montoya	University of Colorado, Boulder
Marcel Loomans	Eindhoven University of Technology
Marina Vance	University of Colorado, Boulder
Mark Jackson	Daikin
Mark Mendell	California Department of Public Health
Martin Täubel	Finnish Institute of Welfare and Health
Marwa Zaatari	Enverid
Marzenna Dudzinska	Lublin University of Technology
Masih Alavy	University of Toronto
Mats Sandberg	University of Gävle
Mauro Masiol	University of Rochester School of Medicine and Dentistry
Max Sherman	Lawrence Berkeley National Laboratory
Michael Sohn	Lawrence Berkeley National Laboratory
Miia Pitkäranta	Vahanen
Ming Shan	Tsinghua University
Mohammad Heidarinejad	Illinois Institute of Technology
Morgan MacNeill	Health Canada
Naomichi Yamamoto	Seoul National University
Nicholas Clements	Delos
Nicola Carlaw	York University
Nicolas Lam	University of Illinois
Nuno Canha	University of Lisbon
Ola Lipczynska	Berkeley Education Alliance for Research in Singapore
Olaf Wilke	BAM
Olivier Ramalho	CSTB
Paolo Carrer	UniMi
Paolo Tronville	Politecnico di Torino
Parham Azimi	Illinois Institute of Technology
Paul Francisco	University of Illinois
Peder Wolkoff	NRCWE, Denmark
Pertti Pasanen	University of Eastern Finland
Peter DeCarlo	Drexel University
Peter McKinney	Consultant
Philip Hopke	University of Rochester School of Medicine and Dentistry
Philomena Bluysen	TU Delft
Rachel Adams	University of California, Berkeley
Raheleh Givchchi	University of Toronto
Rahul Bharadwaj	AAF Flanders
Rengie Chan	Lawrence Berkeley National Laboratory
Ricardo Carvalho	Umea University
Richard Corsi	University of Texas at Austin

Name	Affiliation
Richard Shaughnessy	University of Tulsa
Scott Kelley	San Diego State University
Seema Bhangar	Aclima
Shelly Miller	University of Colorado, Boulder
Shichao Liu	Worcester Polytechnic Institute
Sibel Mentese	Çanakkale University
Somayeh Youssefi	University of Maryland
Stefano Schiavon	University of California, Berkeley
Stephen Jackson	NIOSH
Steve Emmerich	NIST
Stuart Batterman	University of Michigan
Sung-Chul Seo	Korea University
Tom Justice	Consultant
Tom Ben-David	Drexel University
Torben Sigsgaard	Institute of Environmental and Occupational Medicine
Torkan Fazli	Illinois Institute of Technology
Trevor VandenBoer	York University, Canada
Twan Van Hooff	KU Leuven
Ulla Havarinen-Shaughnessy	Tampere University of Technology
Vishal Verma	University of Illinois
Vito Ilacqua	US EPA
Wenhao Chen	California Department of Public Health
William Bahnfleth	Penn State University
William Dols	NIST
William Fisk	Lawrence Berkeley National Laboratory
Wolfgang Horn	BAM
Xiaojing Zhang	Shanghai Jiao Tong University
Xudong Yang	Tsinghua University
Yilin Tian	University of California, Berkeley
Ying Xu	University of Texas at Austin
Yinxin Zhu	Tsinghua University
Yirui Liang	US EPA
Yuexia Sun	Tianjin University
Yuguo Li	University of Hong Kong
Zhiwei Lian	Shanghai Jiao Tong University
Zuraimi Sultan	Berkeley Education Alliance for Research in Singapore



## Session Chairs

We are also grateful for all of those who volunteered as session chairs (listed below). If you are serving as a session chair, please carefully follow the Guide for Session Chairs listed on the next page.

Alireza Afshari	Dustin Poppendieck	Lance Wallace	Peter DeCarlo
Allen Goldstein	Elliott Gall	Lars Gunnarsen	Peter Tappler
Andrea Ferro	Ellison Carter	Laura Kolb	Philip Hopke
Andrew Persily	Erik Uhde	Li Liu	Qingyan Chen
Aneta Wierzbicka	Francis Offermann	Linda Hägerhed	Rachel Adams
Atila Novoselac	Gabriel Bekö	Linsey Marr	Ray Palmer
Atze Boerstra	Geo Clausen	Lulu Weschler	Ray Wells
Benjamin Hanoune	Glenn Morrison	Maciej Goniewicz	Richard Corsi
Bill Bahnfleth	Hal Levin	Marco-Felipe King	Richard Shaughnessy
Bin Yang	Horace Mui	Marina Vance	Sarka Langer
Bjarne Olesen	Hugo Destailats	Mark Jackson	Shelly Miller
Brandon Boor	Hyojin Kim	Mark Mendell	Shichao Liu
Brent Stephens	James Lo	Martin Täubel	Simi Hoque
Brett Singer	Jason Ham	Marzenna Dudzinska	Stephen Jackson
Brian Gilligan	Jeffrey Siegel	Maxence Mendez	Stuart Batterman
Catherine Noakes	Jelena Srebric	Melissa Bilec	Tiina Reponen
Chandra Sekhar	Jelle Laverge	Michael Waring	Tunga Salthammer
Charles Haas	Jensen Zhang	Mickael Derbez	Twan Van Hooff
Charles Weschler	Joel Harrison	Miia Pitkäranta	Ulla Haverinen-Shaughnessy
Christopher Y. H. Chao	John Spengler	Mohammad Heidarinejad	Vito Ilacqua
Chun Chen	Joon-Ho Choi	Morgan MacNeill	William Fisk
Chungyoon Chun	Jordan Clark	Nicholas Clements	William Nazaroff
Chunyi Wang	Jordan Peccia	Nicola Carslaw	Xudong Yang
Claudia Miller	Jovan Pantelic	Nuno Canha	Yilin Tian
Cora Young	Junjie Liu	Paolo Tronville	Yuexia Sun
Corinne Mandin	Karen Dannemiller	Parham Azimi	Yuguo Li
Donald Milton	Kazukiyo Kumagai	Paul Francisco	Zhiwei Lian
Donghyun Rim	Kerry Kinney	Pawel Wargocki	
Dusan Licina	Kwok Wai Tham	Pertti Pasanen	

## ISIAQ Information

INDOOR AIR is the flagship conference of the International Society for Indoor Air Quality and Climate. The current and incoming ISIAQ Board of Directors is provided below.

### Board of Directors

	Current (2016-2018)	Incoming (2018-2020)
<b>Voting Members</b>		
President	Marcel Loomans	Marzenna Dudzinska
President-Elect	n/a	Corinne Mandin
VP Policy	Chungyoon Chun	Chungyoon Chun
VP Research	Corinne Mandin	Ulla Haverinen-Shaughnessy
VP Practice	Harald Meyer	Bradley D. Prezant
Secretary	Brent Stephens	Brent Stephens
Treasurer	Tiina Reponen	Jelle Laverge
Treasurer-Elect	n/a	Mui Horace
Member At-Large	Jelle Laverge	n/a
Member At-Large	Ulla Haverinen-Shaughnessy	n/a
<b>Non-Voting Members</b>		
STC Coordinator	Richard Shaughnessy	Richard Shaughnessy
Chapter Coordinator	Linda Hägerhed	Linda Hägerhed
Society Relations Coordinator	n/a	Martin Täubel
Immediate Past President	Glenn Morrison	Marcel Loomans
<i>Indoor Air</i> Journal Editor	William Nazaroff	Yuguo Li
Student Representative	Elisa Van Kenhove	Sarah Lima Paralovo
President, Academy of Fellows	Yuguo Li	<i>To be announced</i>
President, HB Europe 2017	Marzenna Dudzinska	n/a
President, HB Asia 2017	Jung-Wei Chang	n/a
President, Indoor Air 2018	Michael Waring	n/a
President, HB Asia 2019	n/a	Qihong Deng
President, ISES/ISIAQ 2019	n/a	Dainius Martuzevicius
President, Indoor Air 2020	n/a	Hwataik Han
Trustee	Kerry Kinney	Kerry Kinney
Trustee	Pertti Pasanen	Shin-ichi Tanabe

### ISIAQ Student Award Winners

In 2006, ISIAQ made a commitment to growing its base of student members, believing that today's students are not only the future of the Society, but also the future of this important field. In accordance with this belief, ISIAQ has generously provided 5 Student Conference Support Awards for INDOOR AIR 2018 to support lodging and attendance. Winners of the INDOOR AIR 2018 Student Awards include:

- Prachi Garnawat, RMIT University (Paper 504)
- Jie Yin, Harvard University (Paper 194)
- Hongwan Li, University of Texas (Papers 388 and 396)
- Himanshi Rohra, Dr. B.R. Ambedkar University (Paper 201)
- Zhaoyu Wang, Nanjing University (Paper 191)

## Conference Information

### Badges

Each registered participant will be provided with a name badge. Name badges should be worn at all times during conference events.

### Conference Event Locations

All conference sessions will be held in the Pennsylvania Convention Center in downtown Philadelphia. Podium sessions will be held in the 200 level rooms on the 2<sup>nd</sup> floor of the Convention Center. Poster sessions and exhibitors will be located in Ballroom B on the 3<sup>rd</sup> floor of the Convention Center. Plenaries will be held in Ballroom A on the 3<sup>rd</sup> floor of the Convention Center. The opening ceremony and reception will be held at Drexel University's campus on Sunday evening.

Refer to the Maps and Directions section of this document for more information on the location of each conference event.

### Conference Party

The Conference Party will be held at the Drexel Academy of Natural Sciences on Thursday evening. INDOOR AIR will have exclusive use of the museum and its exhibits. Drinks and small plates will be provided.

Tickets can be pre-ordered until the conference: <https://tinyurl.com/yauj8adp>. The price of the Conference Party is \$75. We will also have a limited number of tickets available for purchase on site on a first come, first serve basis.

The Partner Social Pass is for registrants who are traveling with someone, and it allows you to bring one guest to all the conference social events, including the Conference Party. The price of the Partner Social Pass is \$125. Purchase here: <https://tinyurl.com/yca7tued>. When it asks for your name, enter your name and your partner's name.

### Conference Proceedings

Each registered participant will receive all conference papers on a USB flash drive upon registration. Papers include 2-page maximum Extended Abstracts and 8-page maximum Full Papers. These preliminary proceedings are intended for use by conference participants only. Final proceedings will be made available on the ISIAQ website at a later date.

### Currency and Payments

The United States dollar (\$ or USD) is the official currency of the United States. Most institutions accept credit or debit cards in addition to cash. Currency can be exchanged in the Philadelphia International Airport. ATMs are available from HSBC, Wells Fargo, Cardtronics, PNC Bank, and others within three blocks in all directions of the Convention Center.

### Dress Code

There is no formal dress code for the conference or its events. Social events are casual, and generally "business casual" style dress is recommended for the conference technical events.

### Emergency Numbers

Police, fire, and ambulance: call 911.

### Errors and Omissions

If you notice any errors or omissions from the technical program, author lists, or paper lists, please contact the Technical Program Chair, Brent Stephens, at [brent@iit.edu](mailto:brent@iit.edu).

### ISIAQ Annual General Meeting

The ISIAQ AGM will be held on Tuesday from 12:15 to 13:15 in Ballroom A.

## Lists of Authors and Papers

A full list of all registered authors and papers (including Extending Abstracts and Full Papers) is available online along with the full technical program: <http://indoorair2018.org/program-information/detailed-technical-program>

## Local Customs

It is customary for customers dining at restaurants to tip wait staff (commonly 15-20%).

## Lost and Found

Although the organizers are not responsible for your personal items, there will be a 'lost and found' area in the speaker ready room, which will be staffed with volunteers throughout the conference. If you have lost personal items, please check with volunteers in the speaker ready room (Room 203B in the Convention Center). Similarly, if you find others' personal items, please be kind and bring them to Room 203B and leave them with a volunteer.

## Lunch

Lunch is not provided in your conference registration. A 1.5 hour lunch break is scheduled each day from 12:00-13:30. Participants are encouraged to visit one of the many restaurants surrounding the Convention Center and to return to the Convention Center promptly for the beginning of the 13:30 podium sessions. More information on nearby restaurants is available in the Maps and Directions section of this document.

## Mobile Phones

Please place your mobile phones in "silent" mode during all technical sessions and presentations throughout the conference out of respect for the speakers.

## No Smoking Policy

Smoking is prohibited in the Pennsylvania Convention Center. Outdoor smoking is only permitted 25 feet from the exterior doors. Use of electronic cigarettes have the same restrictions.

## Nursing Station

The Mamava Nursing station for nursing Mothers is located on the 2<sup>nd</sup> floor of the Convention Center between Halls A and B by the spiral staircase.

## Parking

There are many parking options, including garages and surface lots, conveniently located within blocks of the Convention Center. The rates for parking along the perimeter of the building vary. For more information, visit: <https://www.paconvention.com/attendees/travel-to-pa-convention-center/parking>.

## Podium Sessions

Each podium session will consist of up to six podium presentations. Each podium presentation has a 15-minute time slot in the program, intended for a 12-minute talk plus up to 3-minutes for Q&A. Please do your best to arrive to podium sessions on time. Presenters should refer to the Guide for Presenters section for more information on preparing for and giving their podium presentations. Each attendee is permitted to present a maximum of two podium presentations.

## Poster Sessions

Poster sessions will be held in Ballroom B on Monday, Tuesday, and Thursday afternoons, 15:30 to 17:30. Poster sessions are grouped thematically to provide coherent content throughout the poster area. There are 10 poster sessions per day, labeled session A through J, each with up to 8 poster presentations.

Poster presentation sessions will be moderated by a chairperson, who will be responsible for starting the sessions on time and keeping presenters within their allotted time. Each presenter will be given a maximum of 3 minutes to briefly introduce the main idea and findings in their posters with a short oral introduction. Oral introductions, moderated by one chairperson per thematic area, will all begin at the same time and will continue in the order in which posters are placed in each grouped area. The audience will then be given time to interact with poster presenters for the remainder of the duration of each poster session. Audience members are free to move in and out of poster sessions at their own leisure.

As an example of how this will work, for a given poster session with 8 posters scheduled, the first poster presenter will spend a maximum of 3 minutes introducing their poster with an oral introduction. The chairperson will signal when the presenter has 1-minute left, then close the presentation and move down to the next one, which will be presented by the next presenter in the session. This will continue for approximately 24 minutes (3 minutes per poster x 8 posters) until all posters in the session have been introduced. Nine other thematic poster sessions will also occur simultaneously. The presenters and the audience will then have the remainder of the poster session time to discuss their work and move freely between poster sessions.

Poster presenters can refer to the Guide for Presenters section for more information on preparing for and giving their poster presentations.

## Power Outlets

Electric power is standardized at 110 Volts and 60 cycles in all states across the U.S. Standard plugs have two flat blades, while some also using a third grounding pin. If you bring any electrical appliance to the U.S. from other countries, you may need an adaptor to fit the US electrical receptacles. You may also need a converter to change the voltage from 110 volts to 220 volts.

## Refreshments

Refreshments will be available for registered participants during breaks.

## Registration Desk

On Sunday, registration will occur at Drexel University from 15:30 to 18:30 in the Great Court of the Main Building. From Monday to Friday, registration will occur outside of Ballroom B in the Pennsylvania Convention Center, from the hours of 8:00 to 17:00 (only until 16:00 on Wednesday).

## Social Media

The official Twitter account for INDOOR AIR 2018 is @IA2018: <https://twitter.com/ia2018>.

The official hashtag for the conference is #IndoorAir2018.

## Speaker Ready Room

The speaker ready room is located in Room 203B in the Pennsylvania Convention Center. Please bring your podium presentation slides to the speaker ready room on a USB flash drive at least one day prior to your presentation. If you prefer not to use a USB flash drive, you can work with a student volunteer to share your presentation slides via email.

The speaker ready room will be staffed with student volunteers as follows:

- Monday: 8:00 to 17:00
- Tuesday: 8:00 to 17:00
- Wednesday: 8:00 to 16:00
- Thursday: 8:00 to 17:00
- Friday: 8:00 to 14:00

For those presenting in the first session on Monday morning, student volunteers will also be accepting presentation files at the Opening Ceremony on the campus of Drexel University, near the registration desk, from 15:30 to 18:30. It is imperative that you upload your Monday presentation at this time, so that we can effectively start the conference on time.

## Student Party

The student party will be held at North Bowl (909 N 2nd St, Philadelphia, PA) on Monday evening starting at 19:00. Students are recommended to travel to and from North Bowl via taxi, rideshare, or public transit.

## Time Zone

Philadelphia is in the Eastern Daylight Time (EDT) Zone (UTC/GMT -4 hours) during July.

## Transportation Options

There are a variety of affordable transportation options in and around Philadelphia, including:

- Taxi
- Ride-share (e.g., Lyft, Uber)
- Bike share (Indego)
- Bus (SEPTA)
- Subway (SEPTA)
- Regional Rail (SEPTA)
- Trolley (SEPTA)
- Walking (many of the conference events are walkable from the Convention Center and nearby hotels)

## Weather

The average high temperature in July in Philadelphia is 89 °F (32 °C), with an average low temperature of 72 °F (22 °C). Most indoor spaces and public transit are air-conditioned.

## Wi-Fi Internet Access

Wireless Internet access is available in Ballrooms A and B, all 200 level breakout rooms, and in the surrounding public areas. Please use the following SSID and password to access:

**SSID:** IA2018

**Password:** IA2018Philly

## Guide for Presenters

Below is helpful information for preparing and giving your podium and poster presentations.

### Podium Presentations

#### Guidelines

Each podium presentation is given a 15-minute time slot in the program, intended for a 12-minute talk plus up to 3 minutes for a brief introduction and Q&A. Your presentation can either be in 16:9 or 4:3 format. All presentations must be in English and free of commercialization. Presenters may not promote products for commercial gain. Each attendee is permitted to present a maximum of two podium presentations.

#### Preparing your presentation

Each presenter should prepare a 12-minute maximum PowerPoint (preferred) or PDF slide presentation. Some general rules of thumb for preparing presentations include: plan for approximately 1 minute per slide; prepare and view your slides in advance; use font size 18 or larger for all text; ensure that figures, tables, and accompanying text are large and legible; figures are preferable to tables for large amounts of data; and the first slide should show the title of your presentation, author names and affiliations, and the paper ID number. There will be a microphone for speakers, but there is no audio available for computers (so please do not include video or audio files that would require audio amplification).

#### Uploading your presentation

You will need to bring your presentation files on a USB flash drive to upload in the speaker ready room at least **one day prior to your presentation. (If you present on Monday, be prepared to upload your presentation on Sunday at Drexel before the opening ceremony.)** The speaker ready room is located in Room 203B in the Pennsylvania Convention Center. Refer to the speaker ready room section of the General Information section of this document for operating hours. If you prefer not to use a USB flash drive, you can work with a volunteer in the speaker ready room to share your slides via email.

#### Giving your presentation

Please arrive to the room designated for your podium presentation at least 10 minutes prior to the beginning of the session. Introduce yourself to the chair(s). The chair(s) may ask you for clarification on pronouncing your name and/or affiliation. Please also pay attention to the chair(s) periodically during your presentation, as they will give you a signal when you have 3-minutes and again 1-minute remaining for your 12-minute presentation. Stop speaking when the session chair indicates that no time remains. Answer questions succinctly, and we encourage you to follow up with the audience after the session if additional discussion time is needed. Enjoy your time!

## Guide for Presenters

Below is helpful information for preparing and giving your podium and poster presentations.

### Poster Presentations

#### Guidelines

Poster sessions are organized thematically so as to provide coherent content throughout the poster area. These poster presentation sessions will be moderated by a chairperson, who will be responsible for starting the sessions on time and keeping presenters within their allotted time. Each presenter will be given a maximum of 3 minutes to briefly introduce the main idea and findings in their posters with a short oral introduction to many people at one time. There will not be associated slides, but you will stand next to your poster when you introduce it.

#### Preparing your poster

Poster presenters should prepare a hardcopy of their poster and bring it to the conference on their own, to be pinned to corkboards on the day of your poster session. Posters can be designed in portrait or landscape orientation, and can be a maximum of 44 inches (112 cm) wide by 48 inches (122 cm) tall. Prepare your poster text and figures so they are readable from 5 feet (1.5 meters). Each poster must clearly show the Paper ID number associated with the submission.

All posters must be in English and free of commercialization. Presenters may not promote products for commercial gain. Please arrive to the room designated for your poster presentation at least 10 minutes prior to the beginning of the session. Introduce yourself to the chair(s) and prepare to give your brief oral presentation in the order shown on the program.

#### Mounting your poster

Poster sessions are grouped thematically so as to provide coherent content throughout the poster area during each poster session time. There are 10 poster sessions per day (labeled session A through J), each with up to 8 poster presentations per session.

You will pin your poster to a corkboard in the appropriate poster session area in Ballroom B. Clusters of corkboards will be arranged and labeled A through J, corresponding to the label of each poster session provided in the detailed technical program. Posters should be pinned up at least 10 minutes before the poster session starts, although you are welcome to pin them up as early as 12:00 on the day of your session. Posters should be removed by 12:00 the day following your session; otherwise, conference staff members will remove them and discard them.

#### Giving your poster presentation

Give a succinct oral summary of your poster within the 3-minute time frame. The chair(s) will give you a signal when you have 1-minute remaining for your oral poster introduction. The chair will stop your introduction firmly at 3-minutes should you go that long (you are welcome to use a shorter introduction as well). You may then attend the other oral poster introductions in your session if you'd like, but please return to your poster for the remainder of the poster session to engage in discussion with the audience as they browse the area. Enjoy your time!



## Guide for Session Chairs

Below is helpful information for session chairs.

### Conducting the session

The chairperson is responsible for managing each assigned session. Chairpersons should arrive at the designated room at least 10 minutes prior to the beginning of the session. Chairs are expected to open and close sessions on time, to ensure that the speakers of the session are present before the session, and to ensure that presenters are able to make their presentations without disruption.

Each podium presentation is given a 15-minute time slot in the program, intended for a 12-minute talk plus up to 3 minutes for a brief introduction and Q&A. Podium session chairs are expected to briefly introduce each presentation, to alert speakers when there are 3-minutes and again 1-minute remaining in their 12-minute talk, and to stop the speaker if they run over time. If speakers run over time by only 1 minute or so, the chair must ensure that the Q&A time is shortened accordingly. All podium presentations are required to be transferred to the laptops that will be used in each room prior to the session starting. Presenters are not allowed to use their own laptop or USB flash drives in the session.

Poster session chairs are responsible for starting sessions on time, providing maximum 3-minute time periods for oral introductions of each poster presented in the order shown in the technical program, and for stopping speakers from going over time. Session chairs are free to go observe other poster sessions after coordinating their introductory time periods (typically about 30 minutes max, with 8 posters per session x 3 minutes maximum introduction for each session).

### Verification of presenting authors

Before each presentation, the chairperson should verify that the person to speak is listed in the program as one of the authors.

### Staying on schedule

Because there are several parallel poster and podium tracks happening simultaneously, it is imperative that session chairs strictly keep to the start times of each presentation shown in the technical program. This allows for attendees to move from session to session to see the talks they wish to see. If a gap should occur in the time schedule (e.g., there is a no-show) and there is no standby paper to fill in, session chairs should allow the presentation time to pass and start the next presentation only at the time described in the program. Chairs may choose to fill the time with discussion or simply take a break.

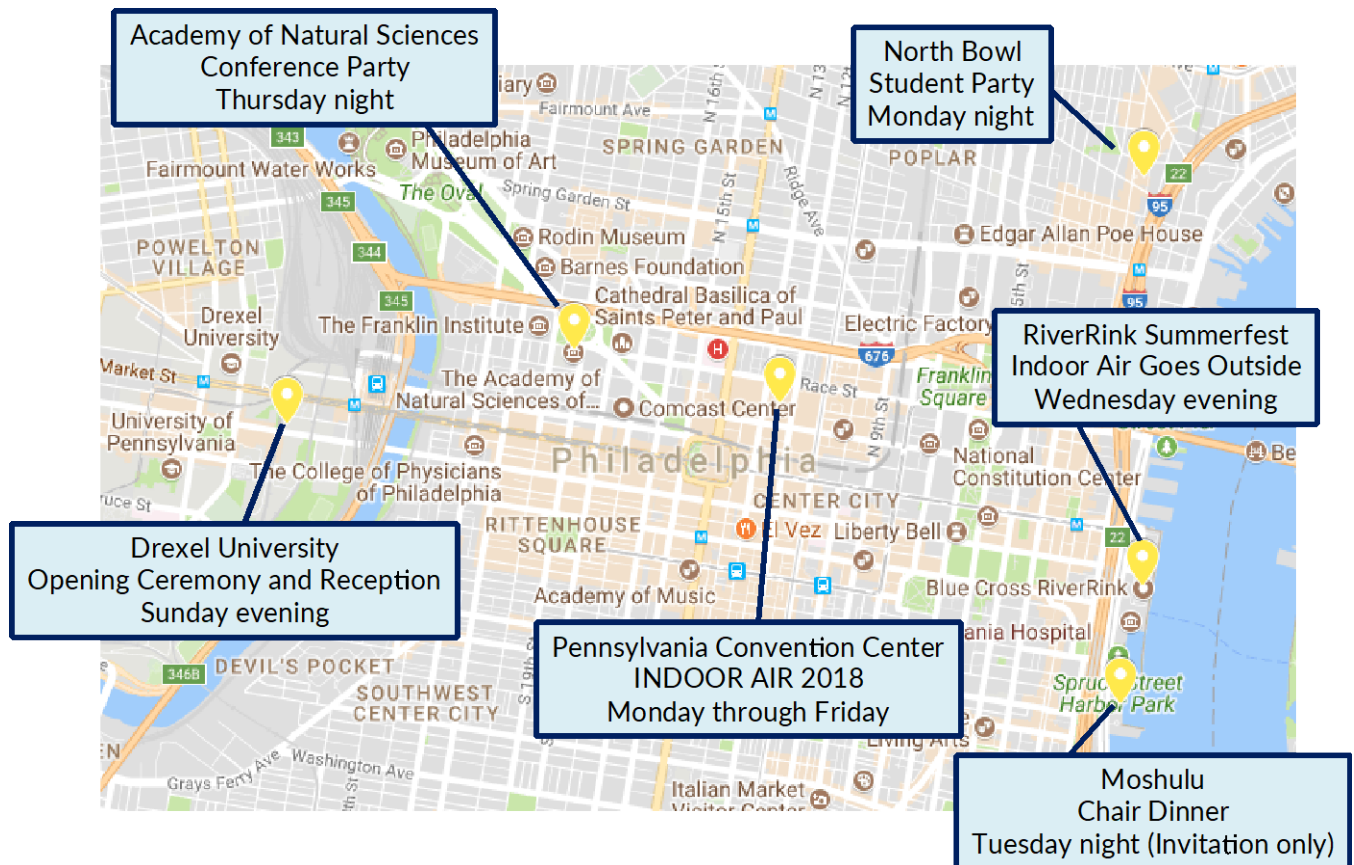
### Assistance

Student and staff volunteers will be checking in on the session areas frequently, including at the beginning of each session, to help with any technical difficulties that may arise. Please alert them if you have a problem.

## Maps and Directions

### All Event Locations

The conference will be held Monday through Friday at the Pennsylvania Convention Center, which is conveniently located in the heart of Center City at 1101 Arch St, Philadelphia, PA. Nearby areas include the convention center district, the historic waterfront district, the museums district, and Chinatown. Pre-conference activities, including the ISIAQ Summer School on Saturday and Sunday, ISIAQ business meetings on Sunday, and the Opening Ceremony and Reception on Sunday evening, will be held at Drexel University. Social events will be held each evening throughout the conference (Monday through Thursday). The map below shows all major event locations:

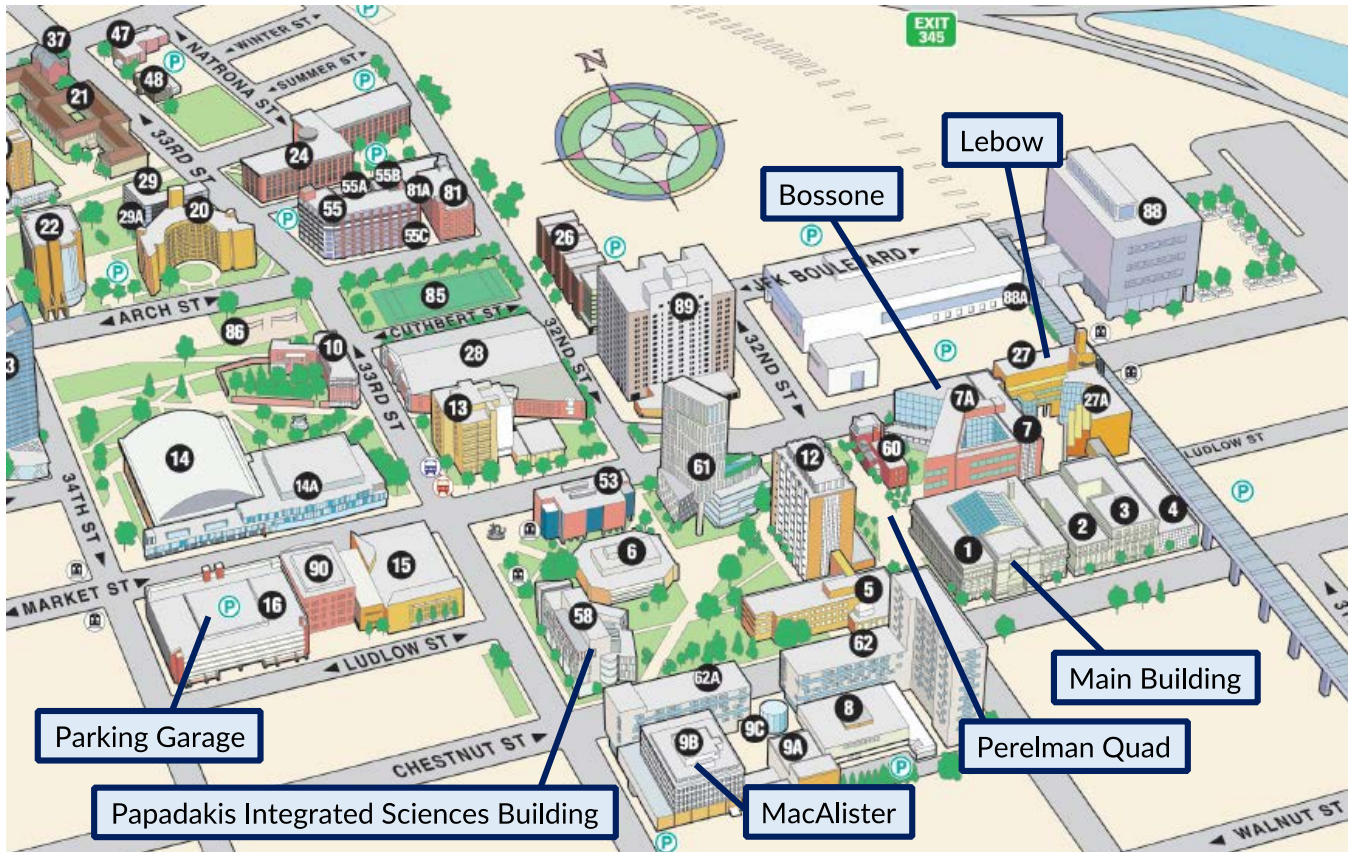


Note that there is a live Google Maps version of this map that also includes several recommended lunch locations near the Convention Center: <https://tinyurl.com/y735pmxl>

# Maps and Directions

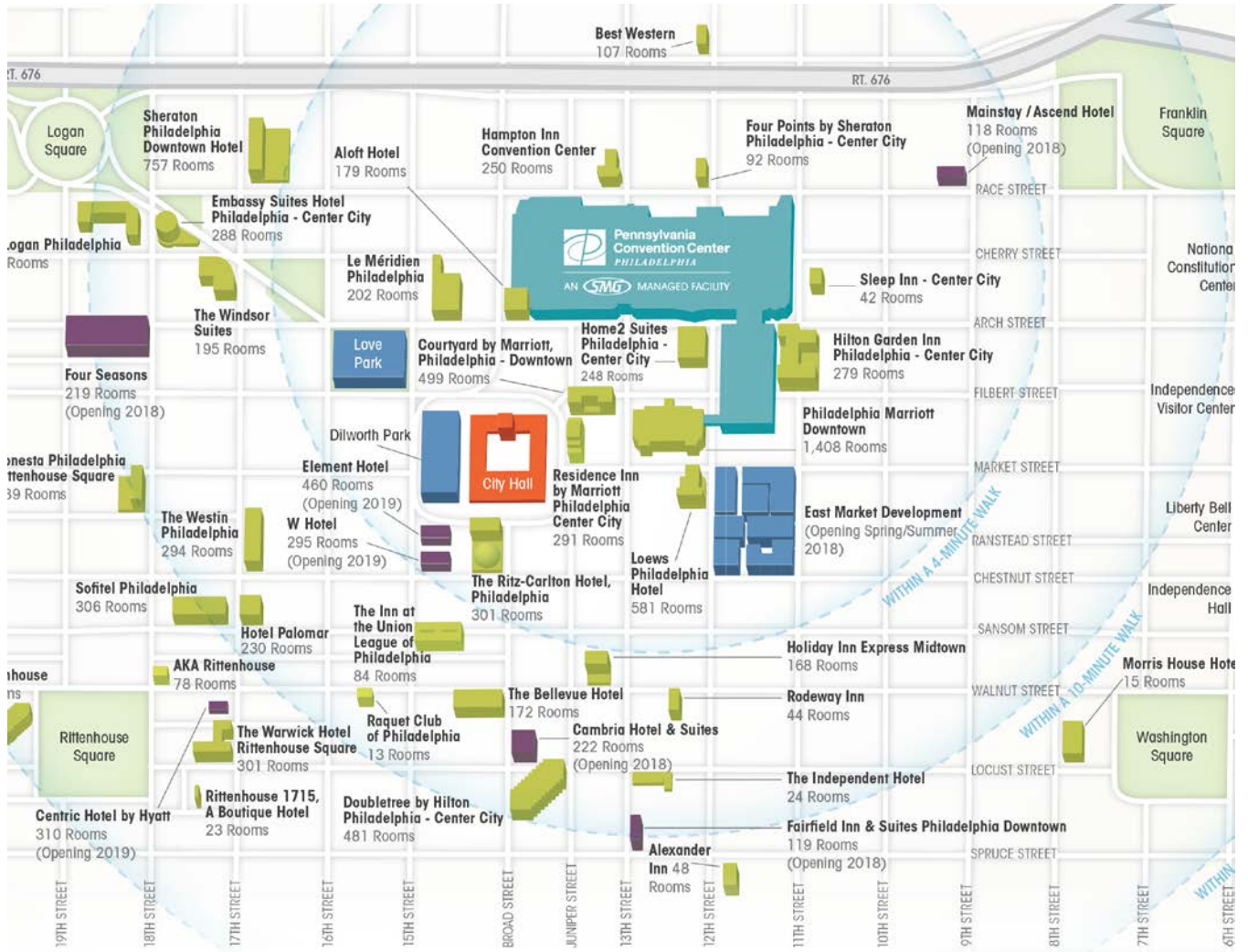
## Drexel University Campus

The ISIAQ Summer School, pre-conference ISIAQ business meetings, opening registration, and the opening ceremony and reception will be held at Drexel University's campus on Sunday evening. For more information on the location and times of these events, please refer to the Opening Ceremony and Weekend Events at Drexel University section of this document.



# Maps and Directions

## Convention Center: Nearby Hotels



### Hotels with negotiated block rates

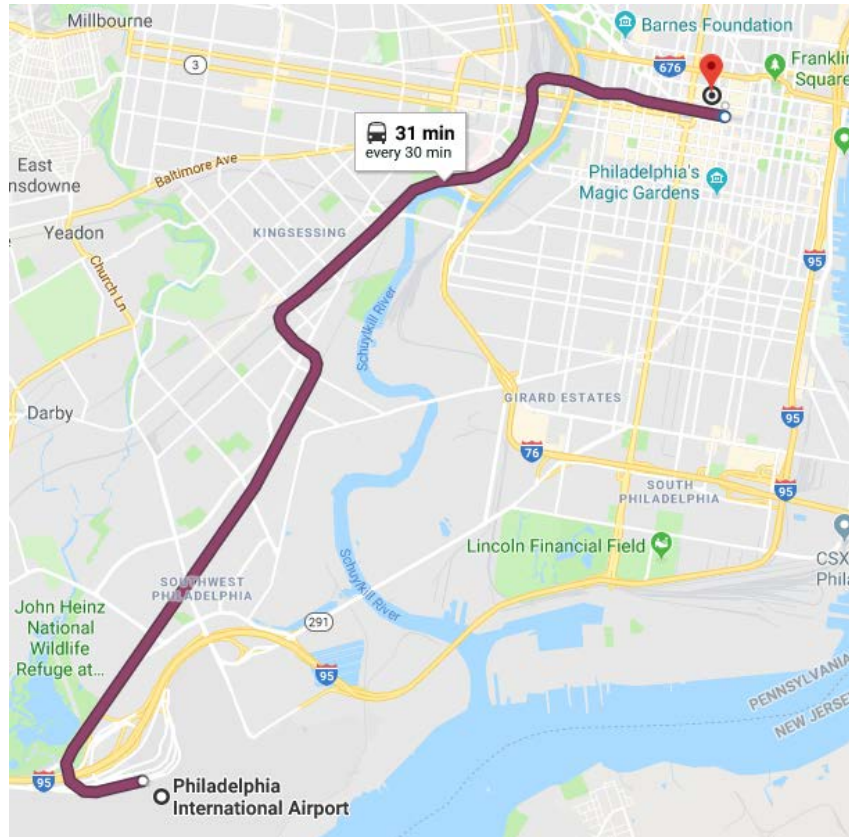
- Club Quarters
- Le Meridian Hotel
- Sheraton Philadelphia Downtown
- Sonesta Philadelphia

### Other nearby hotels

- Hilton Penn’s Landing
- Hyatt at the Bellevue
- The Logan
- The Rittenhouse
- The Study at University City

## Maps and Directions

### Convention Center: Directions



The Southeastern Pennsylvania Transportation Authority, SEPTA, provides train service between Center City and the Airport on the Airport Regional Rail Line. Trains run every 30 minutes and operate from 4:52 to 23:52 (Center City to Airport) and from 5:07 to 0:30 (Airport to Center City). The one-way Regional Rail fare to Center City is \$6.75; or \$9.25 to any other station beyond Center City. To reach the convention center, take the SEPTA train to Jefferson Station. The convention center is just a block away. For more detailed directions to the convention center from the airport via train, visit here:

[https://www.phl.org/Pages/passengerinfo/transportationservices/cct\\_connect.aspx](https://www.phl.org/Pages/passengerinfo/transportationservices/cct_connect.aspx)

For other public transit in and around Philadelphia, visit here:

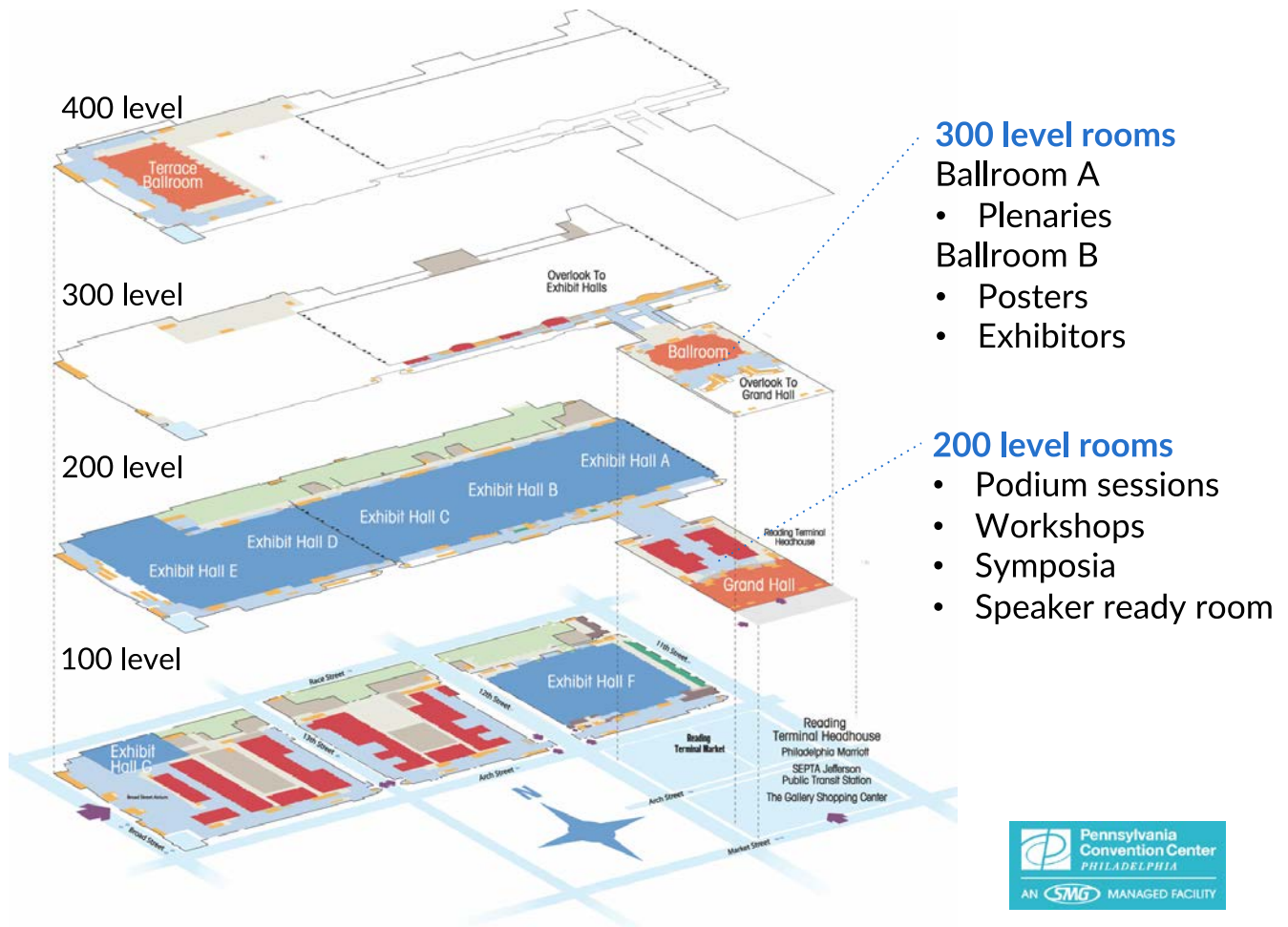
<http://septa.org/maps/system/>

For directions to the convention center by car, visit here:

<https://www.paconvention.com/attendees/travel-to-pa-convention-center/directions>

# Maps and Directions

## Convention Center: Overview Floor Plan





## Opening Ceremony and Weekend Events at Drexel University

The following events are scheduled for the weekend before the conference begins (Saturday, July 21<sup>st</sup>, and Sunday, July 22<sup>nd</sup>):

### ISIAQ Summer School

The 2<sup>nd</sup> edition of the ISIAQ Summer School will be held on Saturday, July 21<sup>st</sup>, and Sunday July 22<sup>nd</sup>, at Drexel University in the Papadakis Integrated Sciences Building (PBIS), Room 106, at 3245 Chestnut Street, Philadelphia, PA 19104. The ISIAQ Summer School will run from 9:30 to 18:00 on Saturday and 9:00 to 16:00 on Sunday. Registration for the ISIAQ Summer School is closed.

### ISIAQ Business Meetings

Three ISIAQ Business meetings will be held on Sunday, July 22<sup>nd</sup>, at Drexel University:

1. **Indoor Air journal meeting: 11:30 – 13:30**  
Hill Conference Room  
LeBow Engineering Center, Room 240  
Market Street and South 31<sup>st</sup> Street, Philadelphia, PA 19104
2. **ISIAQ BOD meeting: 13:30 – 16:30**  
Hill Conference Room  
LeBow Engineering Center, Room 240  
Market Street and South 31<sup>st</sup> Street, Philadelphia, PA 19104
3. **ISIAQ Academy Annual General Meeting (AGM): 17:00 – 18:00**  
Mitchell Conference Room  
Bossone Research Center  
3140 Market Street, Philadelphia, PA 19104

### Opening Registration

Conference registration will occur on Sunday, July 22<sup>nd</sup>, 15:30 to 18:30, in the Great Court in the Main Building at Drexel University, 3141 Chestnut Street, Philadelphia, PA 19104.

### Opening Ceremony

The Opening Ceremony will be held Sunday, July 22<sup>nd</sup>, 18:30 to 19:30, in the Main Building Auditorium at Drexel University, 3141 Chestnut Street, Philadelphia, PA 19104, followed immediately by an Opening Reception outside the Drexel Main Building in the Perelman Plaza quadrangle weather permitting (this will be moved inside to the Great Court if there is inclement weather).



## Social Events

### Student Party – Monday night

The Student Party will be held at **North Bowl (909 N 2nd St, Philadelphia, PA)** on Monday evening starting at 19:00. North Bowl offers bowling, billiards, arcade games, and more! Students are recommended to travel to and from North Bowl via taxi, rideshare, or public transit. Food will be provided.

This event is open to students only.



### Chair Dinner – Tuesday night

The Chair Dinner will be held at **Moshulu (401 S Christopher Columbus Blvd, Philadelphia, PA 19106)** on Tuesday night, starting at 19:00. The restaurant is on-board the Moshulu, the world's oldest and largest four-masted tall ship. Moshulu is a 30-minute walk from the Convention Center (1.5 miles, or 2.4 km).

The Chair Dinner is by **invitation only**.



### Indoor Air Goes Outside – Wednesday evening

Wednesday evening provides an opportunity to break from the conference a little earlier and enjoy games and each other's company at the **Blue Cross RiverRink Summerfest on the Philadelphia waterfront (101 North Columbus Boulevard, Philadelphia, PA 19106)**. Enjoy roller-skating, mini-golf, carnival-style games, a 60-ft-tall (18 m) Ferris wheel, and a buffet of delicious food. This event is open to all registered participants and starts at 18:00. Come and go as you please. Summerfest is a 25-min walk from the Convention Center (1.2 miles, or 1.9 km).



### Conference Party – Thursday night

The Conference Party will be at the **Drexel Academy of Natural Sciences (1900 Benjamin Franklin Parkway, Philadelphia, PA 19103)** on Thursday evening, starting at 18:30. INDOOR AIR will have exclusive use of the museum and its exhibits. Drinks and small plates will be provided. The Academy is a 12-minute walk from the Convention Center (0.5 miles, or 1.2 km).

This event is open only to those who registered for it in advance.



# Technical Program Overview

## Monday, July 23<sup>rd</sup>

Time	Session	Location
8:30	Plenary: Tina Bahadori, US Environmental Protection Agency	Ballroom A
9:00	Plenary: Allen Goldstein, University of California, Berkeley	
9:30	Conference announcements	
10:00	Coffee break	Ballroom B
10:30	<b>Morning podium sessions</b>	
	Air Cleaning and Filtration 1: Aerosol Filtration	201B
	Building Simulation and CFD 1: Transport and Health	204B
	Comfort, Productivity, and Perception 1: Productivity and Performance	201C
	Concentrations and Exposure 1: Novel Approaches	204A
	Sources and Emissions 1: Formaldehyde and VOCs	204C
	Special session - Resilience and adaptation to environmental changes in buildings	201A
	Special session - Integrating ventilation and air cleaning for IAQ control in homes	203A
	Special session - Explorations using distributed sensor networks to improve our understanding of the indoor environment and support practices that enhance health	202A
	Special session - Aerosols: Life as Pig-Pen: Immersed in a Cloud of Particles and Microbes	202B
12:00	Lunch break	
13:30	<b>Afternoon podium sessions</b>	
	Air Cleaning and Filtration 2: Photocatalysis and novel mechanisms	201B
	Building Simulation and CFD 2: Airflows and Methods	202A
	Comfort, Productivity, and Perception 2: Human Responses	201C
	Concentrations and Exposure 2: Schools	204A
	Special session - What are the impacts of humans and their activities on indoor chemistry? (Sponsored by the Sloan Foundation)	201A
	Special session - Smart ventilation: Theory, applications, and case studies	204B
	Special session - Indoor pollutants from emerging smoking and vaping devices: E-cigarettes, “reduced-risk” tobacco products and waterpipes	204C
15:00	Coffee break	Ballroom B
15:30	<b>Poster sessions</b>	
	A: Air Cleaning and Filtration 1	Ballroom B
	B: Building Simulation and CFD 1	
	C: Comfort, Productivity, and Perception 1	
	D: Comfort, Productivity, and Perception 2	
	E: Concentrations and Exposure 1	
	F: Concentrations and Exposure 2	
	G: Sources and Emissions 1	
	H: Sources and Emissions 2	
	I: Ventilation and HVAC Systems 1	
	J: Ventilation and HVAC Systems 2	
17:30	Adjourn	

# Technical Program Overview

## Tuesday, July 24<sup>th</sup>

Time	Session	Location
8:30	Plenary: Gail Brager, University of California, Berkeley	Ballroom A
9:00	Plenary: Xudong Yang, Tsinghua University	
9:30	Conference announcements	
10:00	Coffee break	Ballroom B
10:30	<b>Morning podium sessions</b>	
	Air Cleaning and Filtration 3: Formaldehyde	201B
	Comfort, Productivity, and Perception 3: Green Buildings and Social Housing	201C
	Concentrations and Exposure 3: Formaldehyde	204A
	Microbiology and Dampness 1: Field Studies	204C
	Ventilation and HVAC Systems 1: Specialized Spaces and Controls	204B
	Special session - MOCCIE: first results from a new modelling consortium for indoor air chemistry (Sponsored by the Sloan Foundation)	201A
	Special session - Improving IEQ in schools: the positive health impacts on school community	202A
	Special session - Smart Technologies for Enhancing IEQ	202B
	Special session - Natural Ventilation in China: Dilemma between Energy Use and Indoor Air Quality: Part 1	203A
12:00	Lunch break + <b>ISIAQ Annual General Meeting (12:15-13:15 in Ballroom A)</b>	
13:30	<b>Afternoon podium sessions</b>	
	Comfort, Productivity, and Perception 4: IEQ	201C
	Concentrations and Exposure 4: Influences from Outdoors	204A
	Ventilation and HVAC Systems 2: Energy and Controls	204B
	Microbiology and Dampness 2: Bacterial and Fungal Growth	201B
	Sources and Emissions 2: 3D Printers and Consumer Products	204C
	Special session - Frontiers in indoor air chemistry (Sponsored by the Sloan Foundation)	201A
	Special session - Computational Fluid Dynamics (CFD) modeling of indoor pollutant transport and human exposure	202A
	Special session - Natural Ventilation in China: Dilemma between Energy Use and Indoor Air Quality: Part 2	203A
	Special session - Measuring Ventilation in IAQ Studies of Schools: Challenges and Solutions? (STC 21)	202B
15:00	Coffee break	Ballroom B
15:30	<b>Poster sessions</b>	
	A: Air Cleaning and Filtration 2	Ballroom B
	B: Building Simulation and CFD 2	
	C: Chemistry and Transformations 1	
	D: Comfort, Productivity, and Perception 3	
	E: Concentrations and Exposure 3	
	F: Concentrations and Exposure 4	
	G: Energy, Climate Change, and Policy 1	
	H: Health Effects and Epidemiology 1	
	I: Sources and Emissions 3	
	J: Ventilation and HVAC Systems 3	
16:30	Special session - Growing up in IAQ: Part 1	201A
17:30	Adjourn	

# Technical Program Overview

## Wednesday, July 25<sup>th</sup>

Time	Session	Location
8:30	Plenary: Jordan Peccia, Yale University	Ballroom A
9:00	Plenary: Amy Pruden, Virginia Tech	
9:30	Conference announcements	
10:00	Coffee break	Ballroom B
10:30	<b>Morning podium sessions</b>	
	Air Cleaning and Filtration 4: Sorbents	201B
	Chemistry and Transformations 1: Ozone	202A
	Comfort, Productivity, and Perception 5: Thermal Models and Assessments	201C
	Concentrations and Exposure 5: Indoor Particle Sources	204A
	Sources and Emissions 3: Emissions Testing Methods	204C
	Ventilation and HVAC Systems 3: Natural Ventilation and Infiltration	204B
	Special session - Improving practical microbial assessments for studying occupant health and investigating building health (Sponsored by the Sloan Foundation)	201A
	Special session - Numerical modeling of cross-ventilation flows: overview of past studies and discussion on future directions	202B
	Special session - TILT: Identifying Initiators and Triggers of Chemical Intolerance	203A
12:00	Lunch break+ <b>ISIAQ Chapters Meeting (12:15-13:15 in 201A)</b>	
13:30	<b>Afternoon podium sessions</b>	
	Air Cleaning and Filtration 5: Systems and Performance	201B
	Chemistry and Transformations 2: Novel Advances	202A
	Comfort, Productivity, and Perception 6: Awareness and Control	201C
	Concentrations and Exposure 6: Facilitating Large-scale Exposure Assessments	204A
	Energy, Climate Change, and Policy 1: Household Energy	202B
	Ventilation and HVAC Systems 4: Thermal Comfort and Performance	204B
	Sources and Emissions 4: SVOCs	204C
	Special session - Water on surfaces and dust: Implications for indoor chemistry and microbiology (Sponsored by the Sloan Foundation)	201A
	Special session - Indoor Air Quality in Energy Efficient New Homes: Findings from Field Studies in North America, China and Europe	203A
15:15	<b>ISIAQ STC Meetings</b>	
	STC 11 Source, monitoring, and evaluation: Chemical pollutants	201A
	STC 12 Source, monitoring, and evaluation: Aerosols	201B
	STC 13 Microbes in indoor environments	201C
	STC 21 Ventilation	204A
	STC 22 Air cleaning	204B
	STC 31 Health effects and epidemiology	204C
	STC 32 Environmental/climate impacts	202A
	STC 33 Thermal comfort	202B
16:30	<b>Conference break and outdoor activity</b>	

# Technical Program Overview

## Thursday, July 26<sup>th</sup>

Time	Session	Location
8:30	Plenary: Linsey Marr, Virginia Tech	Ballroom A
9:00	Plenary: Benjamin Cowling, University of Hong Kong	
9:30	Conference announcements	
10:00	Coffee break	Ballroom B
10:30	<b>Morning podium sessions</b>	
	Chemistry and Transformations 3: Methods and Detection	201A
	Concentrations and Exposure 7: Transmission and Dispersion	204A
	Health Effects and Epidemiology 1: Allergy and Asthma	201C
	Microbiology and Dampness 3: Transmission and Transport	201B
	Sources and Emissions 5: Phthalates	204C
	Ventilation and HVAC Systems 5: Transmission and Distribution	204B
	Special session - Applying Quantitative Microbial Risk Assessment (QMRA) to Estimate Human Health Impacts in the Indoor Air Environment	202A
	Special session - Emissions from humans: What do we know and what should we know?	202B
	Special session - How (and why) does filter efficiency change over time?	203A
12:00	Lunch break	
13:30	<b>Afternoon podium sessions</b>	
	Chemistry and Transformations 4: Indoor Sources	201A
	Concentrations and Exposure 8: Transportation, Public Spaces, and Other Environments	204A
	Health Effects and Epidemiology 2: Environmental Conditions and Sleep Environments	201C
	Microbiology and Dampness 4: Methods and Applications	201B
	Sources and Emissions 6: Flame Retardants	204C
	Ventilation and HVAC Systems 6: Fluids and Flows	204B
	Special session - The use of low-cost sensors for monitoring indoor air and exposure	202A
	Special session - Compliance in Ventilation Standards using Natural Ventilation	203A
	Special session - Household energy transitions to address air pollution exposure, health, and climate burdens associated with solid fuel burning	202B
15:00	Coffee break	Ballroom B
15:30	<b>Poster sessions</b>	
	A: Air Cleaning and Filtration 3	Ballroom B
	B: Comfort, Productivity, and Perception 4	
	C: Comfort, Productivity, and Perception 5	
	D: Concentrations and Exposure 5	
	E: Concentrations and Exposure 6	
	F: Energy, Climate Change, and Policy 2	
	G: Health Effects and Epidemiology 2	
	H: Microbiology and Dampness 1	
	I: Sources and Emissions 4	
	J: Ventilation and HVAC Systems 4	
	Special session - Growing up in IAQ: Part 2	
17:30	Adjourn	

## Technical Program Overview

### Friday, July 27<sup>th</sup>

Time	Session	Location
8:30	Plenary: Glenn Morrison, University of North Carolina at Chapel Hill	Ballroom A
9:00	Plenary: Geo Clausen, Technical University of Denmark	
9:30	Conference announcements	
10:00	Coffee break	
10:30	<b>Morning podium sessions</b>	
	Chemistry and Transformations 5: Oxidants and NO <sub>x</sub>	201A
	Concentrations and Exposure 9: Residential Environments	204A
	Energy, Climate Change, and Policy 2: IAQ Policies and Standards	204B
	Health Effects and Epidemiology 3: Health Indicators	201C
	Microbiology and Dampness 5: Moisture Impacts	201B
	Sources and Emissions 7: Field Studies	204C
	Special session - Clothing and other textiles as mediators of personal exposure to indoor pollutants	202A
	Special session - Measurement and experimental challenges in sleep related IAQ studies	202B
12:00	Lunch break	
13:30	<b>Afternoon podium sessions</b>	
	Energy, Climate Change, and Policy 3: Energy, Climate, and IEQ	204A
	Health Effects and Epidemiology 4: Synthesis Studies	201C
	Microbiology and Dampness 6: Future Steps	201B
	Ventilation and HVAC Systems 7: Residential Ventilation and Infiltration	204B
	Special session - Ventilation and Transmission of Influenza and other Respiratory Viruses	201A
	Special session - Translating sleep IEQ research into new residential ventilation standards	202A
	Special session - Healthy building with the WELL building standard	204C
15:00	Coffee break	
15:30	<b>Closing ceremony</b>	
	Closing remarks and conference recap	Ballroom A
	Closing plenary: William Nazaroff, University of California, Berkeley	
17:00	Adjourn	

## Plenary Speakers

Monday, July 23<sup>rd</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A)

### *Beyond the Lamppost: Exposures, Risk Assessment, and Public Health Protection*

Tina Bahadori, US Environmental Protection Agency



Dr. Tina Bahadori is the National Program Director for Human Health Risk Assessment and the Director of the National Center for Environmental Assessment (NCEA) at the US Environmental Protection Agency (EPA). NCEA is a leader in the science of human health and ecological risk assessment, a robust scientific process used to determine how pollutants or other stressors may impact human health and the environment.

### *Bringing Atmospheric Chemistry Home*

Allen Goldstein, University of California, Berkeley

Sponsored by the Alfred P. Sloan Foundation



Dr. Allen H. Goldstein is a Professor in the Department of Civil and Environmental Engineering and in the Department of Environmental Science, Policy, and Management, at the University of California, Berkeley where he served as department chair from 2007-2010. His research program encompasses anthropogenic air pollution, biosphere-atmosphere exchange of radiatively and chemically active trace gases, and development and application of novel instrumentation to investigate the organic chemistry of earth's atmosphere. He engages in field measurement campaigns, controlled laboratory experiments, and modeling activities covering indoor, urban, rural, regional, intercontinental, and global scale studies of ozone, aerosols, and their gas phase precursors.

## Plenary Speakers

Tuesday, July 24<sup>th</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A)

### *The Value of Variability*

Gail Brager, University of California, Berkeley



Dr. Gail Brager has a Ph.D. in Mechanical Engineering, and is a Professor in the Building Science Program of the Dept. of Architecture at the University of California, Berkeley, where she is the Director of the Center for Environmental Design Research, and the Associate Director of the Center for the Built Environment, an industry/university collaborative research center with over 40 industry partners from various sectors of the building industry. She has over 30 years of experience in teaching and research across multiple dimensions of sustainability addressing the design, operation, and assessment of buildings to simultaneously minimize energy consumption while enhancing indoor environmental quality. She has particular interests in thermal comfort and adaptation, occupant well-being, natural ventilation and mixed-mode buildings, and personalized environmental control.

### *Indoor Air Quality Modeling: What Is the Matter and What Matters?*

Xudong Yang, Tsinghua University



Dr. Xudong Yang has educational training and work experiences in both China and the United States. He is presently the Chang-Jiang Chair Professor and Deputy Director of the Institute of Built Environment, Department of Building Science, Tsinghua University, China. Dr. Yang's research interests center on fundamental and practical aspects of indoor environmental quality and sustainable buildings within the following thematic areas: (1) understanding and modeling various indoor air pollutant sources and sinks; (2) developing new air pollutant control technologies for the built environment; and (3) energy intervention and environmental improvement in rural household and communities.



## Plenary Speakers

Wednesday, July 25<sup>th</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A)

### *Controlling Building Microbiomes*

Jordan Peccia, Yale University



Dr. Jordan Peccia is Professor of Environmental Engineering at Yale University where his lab integrates physical aerosol processes with molecular biology-based tools to understand the dynamics and sources of biological aerosols in and out of buildings. He and his students have made important contributions on how building design, operation, and occupancy impact human exposure to microbes and have revealed new associations between building microbial diversity and asthma. Peccia served on the 2017 National Academies of Science, Engineering, and Medicine study on “Microbiomes of the Built Environment”. He is associate editor for the journal *Indoor Air* and a member of the board of directors for the American Association for Aerosol Research. He was inducted into the Connecticut Academy of Science and Engineering in 2017. Peccia is recipient of the major graduate mentoring and engineering teaching awards at Yale University.

### *Metagenomic Insight into Pathogens and Antibiotic Resistance in the Indoor Environment*

Amy Pruden, Virginia Tech



Dr. Amy Pruden is the W. Thomas Rice Professor in the Department of Civil & Environmental Engineering at Virginia Tech. Her research incorporates a microbial ecological perspective towards addressing concerns about growing public health threats, such as opportunistic pathogens and antibiotic resistance. Her current work focuses on built environment water systems, especially premise (i.e., building) plumbing and recycled water distribution systems. She is a recipient of a Presidential Early Career Award in Science and Engineering and the Paul L. Busch Award for innovation in water research.

## Plenary Speakers

Thursday, July 26<sup>th</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A)

### *Nanotechnology and Nanoscience in Indoor Air*

Linsey Marr, Virginia Tech



Dr. Linsey Marr is a Professor of Civil and Environmental Engineering at Virginia Tech. Her research group applies a quantitative approach to track emissions, transport, transformation, and fate of gaseous and particulate pollutants. She is especially interested in emerging and non-traditional pollutants, such as engineered nanomaterials and airborne pathogens. Current research projects focus on (1) developing new models and methods for understanding airborne transmission of infectious diseases, (2) assessing the environmental impacts of engineered nanoparticles, and (3) advancing techniques for predicting the fate of semi-volatile organic compounds in the indoor environment.

### *Aerosol Transmission of Influenza*

Benjamin Cowling, University of Hong Kong



Dr. Ben Cowling is a Professor in Infectious Disease Epidemiology at the School of Public Health at the University of Hong Kong, where he is head of the Division of Epidemiology and Biostatistics. His primary research focus is in infectious disease epidemiology. His research aims to integrate information on transmission dynamics at the individual level with disease burden, severity, and dynamics at the population level. Some of his latest work has focused on the modes of respiratory virus transmission, including the potential for aerosol transmission of particular viruses. He also conducts randomized trials of influenza vaccination strategies.

## Plenary Speakers

Friday, July 27<sup>th</sup> – Morning Plenaries (8:30 – 9:30 Ballroom A)

### *You Are What You Wear: How Clothing Impacts Your Exposure to Indoor Chemicals*

Glenn Morrison, University of North Carolina at Chapel Hill



Dr. Glenn Morrison is a Research Full Professor at the University of North Carolina, Chapel Hill and Past President of the International Society of Indoor Air Quality and Climate (ISIAQ). His research encompasses transport, transformations and exposure assessment of indoor chemicals. Most recent research interests include (1) dermal uptake of indoor contaminants and the influence of clothing, (2) window-opening behavior and its influence on exposure to pollutants of indoor and outdoor origin, (3) chemistry taking place at indoor interfaces.

### *Sensory Perception of Indoor Air Quality. Is Quantifying It “Right” Too Challenging for Practice?*

Geo Clausen, Technical University of Denmark



Dr. Geo Clausen is Professor at The International Centre for Indoor Environment and Energy at the Technical University of Denmark. He has studied various aspects of the indoor environment such as: (1) comparative studies of the relative impact on man of the thermal environment, indoor air pollution and noise; (2) impact of air temperature and humidity on perceived air quality; and (3) dynamics in human exposure to indoor pollutants including the role of ventilation. In the last decade his research has focused on the indoor environment that children at all ages experience and the effects this has on their health, comfort, and learning.

## Plenary Speakers

Friday, July 27<sup>th</sup> – Closing Plenary (15:30 – 16:00 Ballroom A)

### *Poised for Progress: Research Frontiers in Indoor Air Sciences*

William Nazaroff, University of California, Berkeley



William (Bill) Nazaroff is the Daniel Tellep Distinguished Professor Emeritus, Department of Civil and Environmental Engineering, University of California, Berkeley. His research career focused on the physics and chemistry of air pollutants in proximity to people, especially in indoor environments. He also emphasized the development and application of methods for understanding mechanistically the relationship between emission sources and human exposure to pollutants. Bill has served as president of ISIAQ's Academy of Fellows. His PhD was earned in environmental engineering science from the California Institute of Technology; he also has been awarded an honorary doctorate from the Technical University of Denmark. He is co-Editor-in-Chief of *Indoor Air*.

## Special Sessions

In participant-led special sessions, the focus shifts from uncoordinated communication of results from similar research studies to synthesis and creativity. The goal is to bring together (often multidisciplinary) knowledge pertaining to a specific research topic or important professional-practice area, and to systematically explore recent developments and/or new challenges and opportunities. Two types of special sessions are schedule for INDOOR AIR 2018:

**Symposia:** Organizers decide on a specific and timely topic of interest, and the conveners invite selected experts to submit papers specifically for that session, or the conveners assemble relevant papers from those submitted generally. Here, the state-of-the-art is consolidated, and a broad foundation for a research agenda on a new or existing question can be established.

**Workshops:** Based on a prompt in the form of an introductory presentation, the audience is engaged in a moderated discussion or collaborative exercise, potentially guided with a panel of experts. The main target in this format might be, for example, to strive for consensus on answering a provocative question, or to probe the group for opinions and interest on a newer research topic, or to propose a novel approach to an older problem. Other examples are topic-targeted STC meetings, public meetings for research consortia or large international projects, etc.

A total of 23 Symposia and 8 Workshops were selected from proposals submitted for consideration. Each of these special sessions is organized alongside other podium talks in the conference technical program. A full list of Symposia and Workshops is provided on the subsequent pages.

Special session conveners should designate one or two session chair(s) among them who will be responsible for leading the session and processing and reporting the content generated in their session (irrespective of the format), either in structuring existing knowledge or through innovative ideas, in a position paper that will be included in the *Proceedings*.

## Symposia

### Symposium 1: Resilience and adaptation to environmental changes in buildings

Monday morning podium

Room 201A

Chairs: Kazukiyo Kumagai, Vito Ilacqua

The primary goal of the symposium is to develop a framework for designing and managing buildings to respond to indoor impacts of environmental changes, such as extreme weather events, changes in moisture, and wildfires. The ability of buildings to maintain healthy indoor environments under changing ambient conditions is a necessary pre-requisite for developing community resilience to a variety of environmental changes, including, but not limited to, those driven by a dynamic climate. By identifying critical factors and system design features from the latest research, we can contribute to developing guidelines for local and state authorities, professional societies, and the public that would diminish the public health impact of environmental changes.

## Symposium 2: Integrating ventilation and air cleaning for IAQ control in homes

Monday morning podium

Room 203A

Chairs: Brett Singer, Jeffrey Siegel

The aim of this session is to critically consider what equipment and approaches should be required in homes to manage indoor air quality. In particular, we will explore the balance between ventilation and air cleaning in different environments and building contexts. The indoor air community has long explored the value of ventilation and the importance of matching ventilation amounts and needs. Most jurisdictions rely on ventilation standards for new residential buildings and some ventilation standards allow a credit for air cleaning. However, the modern residential context for ventilation is complicated because of diversity of the global housing stock and the fact that many urban areas have high levels of ambient pollution. The questions that we will address in this symposium include: 1) Whether all the normal IAQ challenges can be addressed with air cleaning? 2) Should the balance between ventilation and air cleaning change in environments with higher levels of ambient pollution? 3) How should ventilation and air cleaning change for high performance homes? 4) What are appropriate ventilation and air cleaning change for multifamily residential buildings?

## Symposium 3: Explorations using distributed sensor networks to improve our understanding of the indoor environment and support practices that enhance health

Monday morning podium

Room 202A

Chairs: Brian Gilligan, Seema Bhangar, Casey Lindberg, Juan Palacios, Jovan Pantelic, Priya Premchandran, Lauren Riggs, Chenlu Zhang

We will explore how using distributed sensor networks to measure Indoor Environmental Quality (IEQ) factors like carbon dioxide (CO<sub>2</sub>), Temperature (T), and Relative Humidity (RH) might enable building owners to extend their practices and policies beyond comfort and safety goals toward enhancing the health and cognitive performance of occupants in office buildings. The symposium will present four novel findings from recent research conducted by the United States (US) General Services Administration (GSA) and Google, Inc. We will discuss connections between IEQ and buildings, the value and limitations of sensing, and next steps for translating these findings into practice.

## Symposium 4: What are the impacts of humans and their activities on indoor chemistry?

Monday afternoon podium

Room 201A

Chairs: Peter DeCarlo, Cora Young

*Sponsored by the Sloan Foundation*

Chemistry initiated by the presence of humans and their activities can play an important, but poorly understood, role in indoor air quality. Occupant driven processes such as emission of reactive chemicals either from humans or from human activity lead to a variety of indoor chemical phenomena including gas/particle phase partitioning, new particle formation and growth, oxidative chemistry, photochemistry, and interactions with outdoor pollutants. Detailed measurements with a new generation of analytical instrumentation provide a wealth of new data to investigate these chemical processes, and better understand the role of human impact to indoor chemistry required to constrain the impact of these processes. This session will increase our understanding of the effects of human occupancy and human activities on gas and particle phase chemistry in the indoor environment. The state of the science of analytical measurement techniques and indoor chemical processes, as well as remaining gaps in our knowledge, will be reported in the *Proceedings*.

## Symposium 5: Smart ventilation: Theory, applications, and case studies

Monday afternoon podium

Room 204B

Chairs: Brent Stephens, Jelle Laverge, Brett Singer, Iain Walker, Andrew Persily

The aim of this session, led in part by members of ISIAQ STC 21 on Ventilation, is to provide a coherent collection of paper presentations involving the theory, applications, and case studies of “smart ventilation” strategies and technologies. Ventilation has been identified as a key driver of indoor air quality, health, and productivity through decades of previous research, but only recently have we begun to explore novel concepts in how we provide ventilation in buildings in a more intelligent manner that minimizes energy use and the transport of outdoor pollutants, while meeting or exceeding ventilation rate requirements. The session will consolidate work in these areas into a format that summarizes the state-of-the-art of the field for conference attendees, while also establishing a vision for how research and practice can integrate in the future for implementing smarter ventilation strategies and systems in residential and commercial buildings.

## Symposium 6: Indoor pollutants from emerging smoking and vaping devices: E-cigarettes, “reduced-risk” tobacco products and waterpipes

Monday afternoon podium

Room 204C

Chairs: Hugo Destailats, Maciej Goniewicz

This session will address the state of the science on fast evolving topics related with widespread consumption of emerging tobacco products, including electronic cigarettes, vaporizing devices, heat-not-burn products, and waterpipes. The focus will be on describing the chemical composition of emissions, secondhand exposures and health impact on exposed populations. We will expand the scope to reduced-risk tobacco products (as defined by the US FDA) and to other smoking devices that are growing in popularity among youths, such as waterpipes and marijuana vaporizers.

## Symposium 7: MOCCIE: first results from a new modelling consortium for indoor air chemistry

Tuesday morning podium

Room 201A

Chairs: Nicola Carslaw, Manabu Shiraiwa

*Sponsored by the Sloan Foundation*

The aim of this session is to report the latest findings from the MOCCIE (MOdelling Consortium for Chemistry of Indoor Environments) consortium, part of an Alfred P. Sloan funded program to study Chemistry of Indoor Environments (CIE). A series of overview papers will describe highlights from the first year of research and detail future plans. This session will be of wide interest, given the MOCCIE consortium is combining state-of-the-art models describing molecular level dynamics, diffusion of indoor air pollutants through skin and clothing, detailed gas- and particle-phase chemistry and CFD (computational fluid dynamics) to develop the next generation of indoor air chemistry models.

## Symposium 8: Improving IEQ in schools: the positive health impacts on school community

Tuesday morning podium

Room 202A

Chairs: Ulla Haverinen-Shaughnessy, Richard Shaughnessy

Over the last two years, scientists have been working in a US western state school district, hosting 32,000 students in over 50 schools. The District is implementing an unprecedented \$500+ million bond program focused on conserving energy and other natural resources, and protecting student and staff health. The program provides a rare and significant opportunity for scientific evaluation of the potential co-benefits that can be realized in the school population, and the positive impacts within the community. The aims of this session are to discuss the framework for assessing the program's effects on students' health and the school community and to provide a venue for presenting findings from other school retrofit projects submitted to the conference. A discussion period will follow presentations.



## Symposium 9: Smart Technologies for Enhancing IEQ

Tuesday morning podium

Room 202B

Chairs: Kwok Wai Tham, Benjamin Hanoune, Horace Mui, Rukshala Anthon

The objective of the symposium is to present recent developments and applications in the use of smart technologies for enhancing indoor environmental quality. In particular, focus is given to the development and deployment of integrated sensors and sensing technologies, data analytics, communication, and user interaction. Smart technologies have begun to pervade the built environment, making rapid advances in the sensing, analysis and use of data on a massive scale. For the indoor environment, what do these advancements herald? Would a more comprehensive and holistic monitoring of the indoor environmental parameters, in space and time, be easily achievable? If so, how would data analytics transform the accuracy of and the pace with which such information is obtained, communicated and acted upon? What would be the place of humans in this evolution, and how is human-centricity maintained or even enhanced?

## Symposium 10: Natural Ventilation in China: Dilemma between Energy Use and Indoor Air Quality: Part 1

Tuesday morning podium

Room 203A

Chairs: Tengfei Zhang, Junjie Liu

Due to severe outdoor and indoor air pollution, natural ventilation has been perceived not working in China. More and more buildings in China start to use mechanical ventilation to control indoor air quality. Mechanical ventilation would use considerable amount of energy. On the other hand, natural ventilation has been a very popular, traditional method in China, especially in southern China. Natural ventilation does not use energy but cannot control the penetration of outdoor pollutants to indoors. The aim of this session is to show the current status of ventilation and IAQ, to identify contaminant sources and their strengths, to develop models that can be used for studying and designing ventilation and IAQ, and to find solutions for ventilation and IAQ in Chinese homes. We will not only debate the pros and cons of natural ventilation based on measured indoor air quality and ventilation data but will stimulate discussion among audience to learn their experience and lessons on ventilation and IAQ in other countries. Part 1 of 2.

## Symposium 11: Frontiers in indoor air chemistry

Tuesday afternoon podium

Room 201A

Chairs: Nicola Carslaw, Ray Wells

*Sponsored by the Sloan Foundation*

The aim of this session is to report research at the frontiers of indoor air chemistry, whether that be carried out in the field, through laboratory experiments or via model simulations. We envisage that the reported research will be novel, highly interdisciplinary in nature and subsequently, of wide interest to ALL who study indoor air chemistry. Through a combination of invited presentations and assembled papers from the wider submission of abstracts, we put together a program that highlights the most cutting edge research efforts in this area.

## Symposium 12: Computational Fluid Dynamics (CFD) modeling of indoor pollutant transport and human exposure

Tuesday afternoon podium

Room 202A

Chairs: Donghyun Rim, Li Liu

In this session, we will discuss/summarize the state-of-the-art CFD modeling techniques and main research findings for studying heterogeneous pollutant distribution in building environments. The session aims to identify strengths and weaknesses of CFD modeling studies in pollutant dynamics and human exposure at four different scales: 1) near-body scale; 2) room scale; 3) whole building scale; and 4) urban scale. At these four scales, we expect to determine practical issues in applying CFD modeling to pollutant dynamics and discuss future research directions for indoor CFD modeling community.

## Symposium 13: Natural Ventilation in China: Dilemma between Energy Use and Indoor Air Quality: Part 2

Tuesday afternoon podium

Room 203A

Chairs: Jingjin Pei, Qingyan Chen

Due to severe outdoor and indoor air pollution, natural ventilation has been perceived not working in China. More and more buildings in China start to use mechanical ventilation to control indoor air quality. Mechanical ventilation would use considerable amount of energy. On the other hand, natural ventilation has been a very popular, traditional method in China, especially in southern China. Natural ventilation does not use energy but cannot control the penetration of outdoor pollutants to indoors. The aim of this session is to show the current status of ventilation and IAQ, to identify contaminant sources and their strengths, to develop models that can be used for studying and designing ventilation and IAQ, and to find solutions for ventilation and IAQ in Chinese homes. We will not only debate the pros and cons of natural ventilation based on measured indoor air quality and ventilation data but will stimulate discussion among audience to learn their experience and lessons on ventilation and IAQ in other countries. Part 2 of 2. (Part 1 of 2 is Tuesday morning.)

## Symposium 14: Improving practical microbial assessments for studying occupant health and investigating building health

Wednesday morning podium

Room 201A

Chairs: Rachel Adams, Mark Mendell

*Sponsored by the Sloan Foundation*

Currently, there are no practical, validated strategies for environmental microbial identification in buildings that meet two kinds of research needs: those of researchers who are studying health effects of microbial exposures in buildings, and those of investigators of moisture and microbial growth in buildings, who may need to assess the need for remediation or the adequacy of remediation already performed. Current microbial identification methods used in damp buildings are thus not yet adequate for assessing either human health or building health. In this session, our goal will be to stimulate a focused discussion on how to make microbial identification methods more informative for both occupant health studies and microbial investigations. The focus will be on making sequence-based/molecular methods (e.g., next-generation sequencing, polymerase chain reaction/qPCR) of microbial identification more comprehensive and fully quantitative. Our approach will be to bring together speakers to discuss (1) current limitations in using microbiologic measurements to study human health effects in buildings or to investigate water-damaged buildings; (2) strategies they have used to improve the application of these microbiological measurements; and (3) ideas for improving future microbial identification methods to be more comprehensive and quantitative. Following the presentations, we will engage the speakers and the audience together to discuss current limitations and generate promising approaches for improved, practical microbiological assessment in buildings.

## Symposium 15: Numerical modeling of cross-ventilation flows: overview of past studies and discussion on future directions

Wednesday morning podium

Room 202B

Chairs: Twan Van Hooff, Marco-Felipe King

Cross ventilation can be used to provide a healthy and comfortable indoor environment in buildings. Moreover, cross ventilation is often applied as passive cooling technique to reduce mechanical cooling demands (i.e., ventilative cooling, night cooling). Cross-ventilation flows can be predicted using numerical models, of which a variety exists and has been used to obtain information on the flow fields around and in cross-ventilated buildings. The aim of the session is twofold: (1) to provide an overview of numerical modeling techniques employed in the past for the assessment of cross-ventilation flows (e.g. RANS, LES, Lattice Boltzmann, airflow networks); (2) to have an interactive discussion with the audience on which numerical techniques are most suitable for different purposes, with a special focus on the required level of detail, the accuracy of the numerical technique and the computational demand related to the numerical techniques available.

## Symposium 16: TILT: Identifying Initiators and Triggers of Chemical Intolerance

Wednesday morning podium

Room 203A

Chairs: Claudia Miller, Ray Palmer

Toxicant Induced Loss of Tolerance (TILT) is a disease mechanism associated with chemical intolerance. Exposures commonly associated with TILT include construction, chemical spills, pesticide applications, household products, and military exposures. Symptoms are persistent and disabling for a susceptible subset of the population. Researchers and doctors have documented this phenomenon in more than a dozen countries where people speak different languages and have different media. Why doesn't everyone who is exposed get sick, and why don't those who get sick get better once the exposure stops? Most doctors didn't learn about TILT during medical school. TILT is a two-stage disease process initiated by a single major exposure, or a series of low-level chemical exposures (Stage I, Initiation). Affected individuals experience diverse, long-lasting symptoms that are subsequently triggered by everyday chemicals, foods, and drugs that did not previously bother them (Stage II, Triggering). Participants will have an opportunity to complete a three-item screening questionnaire for CI called the Brief Environmental Exposure and Sensitivity Inventory (BREESI), as well as a brief home environmental inventory. A live, interactive data feedback system will be used to enable presenters to immediately display and discuss results.

## Symposium 17: Water on surfaces and dust: Implications for indoor chemistry and microbiology

Wednesday afternoon podium

Room 201A

Chairs: Jeffrey Siegel, Karen Dannemiller

*Sponsored by the Sloan Foundation*

Dampness has an established negative impact on health, yet we do not fully understand how increased moisture influences changes in human exposure. This water plays an important role in both indoor chemistry and microbiology. In many problems, the key parameter is available water. Available water is often defined at equilibrium conditions; however, conditions in buildings are often highly transient. Water availability is influenced by wetting/drying dynamics as well as changes in conditions that lead to condensation or adsorbed water amounts, and release of liquid water from enclosure or plumbing leaks, air conditioning condensate, and indoor water sources. When water is available it often is a key driver of microbiological growth. Adsorbed and liquid water also provide pathways for chemical reactions that are distinct from those that occur in the gas phase. Additionally, we often lack appropriate measurement approaches to characterize available water in indoor environments. Improved understanding of water availability in indoor environments is critical to both understanding chemical and microbial process as well as determining the influence of moisture in homes on human health. This session will explore the role of water in indoor chemical and microbiological processes. The talks and discussion will consider the role of water in different indoor microenvironments (dust, HVAC systems, surfaces) and address issues of measurement and characterization of available water for chemistry and microbiology.

## Symposium 18: Indoor Air Quality in Energy Efficient New Homes: Findings from Field Studies in North America, China and Europe

Wednesday afternoon podium

Room 203A

Chairs: Brett Singer, Mickael Derbez, Sarka Langer, Junjie Liu, Morgan MacNeill, Peter Tappler, Wanyu Chan

The goal of this symposium is to share data and analyses relevant to the question of whether there should be particular concerns about indoor air quality in energy-efficient new homes. The symposium will include studies from 5 different countries (China, US, France, Austria, Sweden) and a presentation about VOCs in new homes that will reference studies from around the world.

## Symposium 19: Applying Quantitative Microbial Risk Assessment (QMRA) to Estimate Human Health Impacts in the Indoor Air Environment

Thursday morning podium

Room 202A

Chairs: Charles Haas, Linsey Marr

QMRA has been applied to estimate human health risks in multiple contexts. In indoor air, it has been used to estimate inhalation risks from bacteria and viruses, with limited information on fungi. This symposium will present the principles of QMRA applied to estimating risk from inhaled particles from the indoor environment. The framework will be shown, issues with estimating source strength of microorganisms to the indoor air environment and respirable fractions will be discussed, and issues with applying analytical methods (especially those relying upon molecular methods) will be presented. Limitations and data gaps will be formulated particularly with the improved ability to directly sequence air samples. We expect the outcome will be a summary of the state of the art of QMRA in indoor air.

## Symposium 20: Emissions from humans: What do we know and what should we know?

Thursday morning podium

Room 202B

Chairs: Pawel Wargocki, Sarka Langer, Gabriel Bekö

This session aims to summarize the current knowledge on human bioeffluents and discuss how to advance this knowledge through future research studies. The presentations will provide information on the pollutants emitted by humans, on factors that influence and/or modify these emissions, on differences between pollutants emitted from different body parts and on the effects of bioeffluents on humans, in particular on comfort (perception of air quality and odor), acute health symptoms and cognitive performance. Examples of how human bioeffluents can be quantified in field will be given. The discussion will be focused on the insufficiency of the present knowledge and future research. The aim will be to identify strategic directions for future experiments that will not only advance our knowledge on human bioeffluents beyond the present state of the art but will also allow to technically deal with these emissions.

## Symposium 21: How (and why) does filter efficiency change over time?

Thursday morning podium

Room 203A

Chairs: Jeffrey Siegel, Brandon Boor

Filtration efficiency is dynamic rather than static. The conventional model is that filters increase in efficiency as they load with particles. This is true for filters that rely on primarily mechanical means to remove particles. However, approximately half of the current global filtration market is composed of filters that use charged media and rely on electrostatic forces to remove particles. There is ample documentation that such filters can decline in efficiency as they age, but there is substantial variation in the amount of decline that occurs. Some filters in some building experience dramatic declines in performance and others experience negligible changes in efficiency. The aim of this session is to summarize the factors that influence changes in filtration performance during ageing and outline future research needs to better predict changes in size-resolved filtration efficiencies and pressure drops of filters over their service life. This information is essential to understanding the actual performance of particle filters used in buildings.

## Symposium 22: The use of low-cost sensors for monitoring indoor air and exposure

Thursday afternoon podium

Room 202A

Chairs: Andrea Ferro, Philip Hopke

The use of low-cost sensors for assessing indoor air quality and human exposure to pollutants is increasing as the sensors are becoming more reliable and less expensive. The low-cost sensors can be used to increase the temporal and spatial resolution of air quality measurements, but the low-cost sensors have performance limitations. The speakers for this session will assess both the advantages and the limitations of low-cost sensors with the goal of determining their usefulness for indoor air and exposure studies. In this session, we propose to characterize the utility of low-cost sensors for monitoring indoor air and exposure. Researchers who have deployed low-cost monitors for laboratory and field studies will discuss their findings.

## Symposium 23: Clothing and other textiles as mediators of personal exposure to indoor pollutants

Friday morning podium

Room 202A

Chairs: Glenn Morrison, Charles Weschler, Gabriel Bekö, Tunga Salthammer, Dusan Licina

Clothing has recently been identified as an important mediator of exposure to indoor pollutants. Clothing can be protective, by acting as a physical barrier and also by sorbing or reacting with airborne chemicals. However, clothing and other textiles (e.g. bedding) can accumulate chemicals and particles and contribute to the overall body burden via dermal uptake, inhalation and ingestion. Mechanisms controlling this exposure have been hypothesized, but experimental evidence supporting specific mechanisms is limited. In this session, we will identify key open questions and short-term research goals to advance our knowledge of the impact of clothing and other textiles on exposure to pollutants of indoor origin.

## Workshops

### Workshop 1: Aerosols: Life as Pig-Pen: Immersed in a Cloud of Particles and Microbes

Monday morning podium

Room 202B

**Chairs:** Yilin Tian, Rachel Adams, Martin Täubel, Charles Weschler, Andrea Ferro, Brandon Boor  
Human-driven resuspension can be the most significant indoor emission source of coarse-mode ( $> 1 \mu\text{m}$ ) abiotic and biological particulate matter. The aim of this session is to bring together an interdisciplinary panel to summarize the current state of knowledge and identify future research directions pertaining to indoor particle resuspension and desquamation; the factors which govern particle adhesion to surfaces, detachment into the air, and transport within the perihuman environment; and the implications of the Pig-Pen effect for human inhalation exposures to the microbial, allergenic, and chemical content of indoor dust.

### Workshop 2: Measuring Ventilation in IAQ Studies of Schools: Challenges and Solutions? (STC 21)

Tuesday afternoon podium

Room 202B

**Chairs:** Richard Shaughnessy, Andrew Persily, Stuart Batterman

Indoor air quality in schools is a topic of much interest given the linkages between indoor environments and student performance and health outcomes. Many studies have been conducted internationally to better understand these linkages and to better understand the important building, occupant and environmental factors. Characterizing ventilation performance and estimating outdoor air change rates has been a challenge in all of these studies due to the complexity of the building and HVAC system layouts, limitations in the time and money available for the studies, and a limited understanding of ventilation design and performance on the part of some investigators. The use of carbon dioxide to estimate air change rates presents an additional challenge due to the underlying assumptions that must be met for carbon dioxide-based approaches to be useful. This session is intended to explore these challenges in hopes of informing on the usefulness for ventilation characterization in future IAQ studies in schools. Among other topics, the need to design one's measurements based on the building and HVAC system layout will be stressed, as well as the need to characterize measurement uncertainty, including the importance of repeating measurements and using multiple techniques when possible. IAQ studies in schools will be described to explore approaches that have been used, and attendees will be invited to describe their studies and the challenges they have faced in their work.

## Workshop 3: Compliance in Ventilation Standards using Natural Ventilation

Thursday afternoon podium

Room 203A

Chairs: James Lo, Brent Stephens

Currently, ASHRAE Standard 62.1 provides very little information on how to comply with the standard when using NV. The NV portion in the standard is conceived as an alternative to the mechanically driven ventilate rate procedure (VRP) and indoor air quality procedure (IAQP) and contains very limited language, in part due to the complexity of natural ventilation airflows, including their inherently transient nature. With the only real compliance path currently set to a specific percentage of opening size per floor area (which is the same as CIBSE's AM10), designers and engineers who want to leverage NV strategies that rely on engineered systems (e.g., trickle ventilators, solar chimneys, etc.) have no real guideline nor a clear path for compliance under the current standard. In this session, we will consider ways to leverage existing literature, knowledge, and methodologies to demonstrate a path to satisfy the VRP or IAQP standard with NV, taking into account its unsteady nature. In this session, we aim to determine the meaning of "compliance" in terms of satisfying the ventilation requirements in ASHRAE Standard 62.1 using natural ventilation (NV). The discussion aims to work toward a framework for consolidating the inherently transient nature of airflow rates under natural ventilation conditions with the single ventilation requirement in the standard that is more consistent with steady-state mechanical ventilation system operation. It is expected that the discussion will produce a consensus on how to demonstrate that NV is sufficient for a building (i.e., compliant with the 62.1 standard).

## Workshop 4: Household energy transitions to address air pollution exposure, health, and climate burdens associated with solid fuel burning

Thursday afternoon podium

Room 202B

Chairs: Ellison Carter, Nicholas Lam, Zoe Chafe, Ricardo Carvalho, Ming Shan, John Ackerly, Forrest Lacey

Residential space heating and cooking are critical household energy service needs worldwide. Demand for these services is driven by local environmental (e.g. land-use), climate, and seasonal conditions. In areas where heating is required, homes reliant on solid fuels (i.e. biomass, coal, trash) for cooking often rely on solid fuels for heating as well. Homes relying on traditional cooking devices likely also use inefficient heating devices (e.g. fireplaces, outdated stoves and boilers, or open fires), which like the cooking devices, produce high emissions that adversely impact indoor and outdoor/ambient air quality, personal exposure, and health. This session will discuss and debate research, implementation needs, and advances related to use of solid fuel for meeting residential heating needs and its associated impacts on indoor and outdoor air quality, health, and climate. We will examine past and present policies, approaches, and technologies aimed at mitigating health and climate burden associated with pollutant emissions from solid fuel space heating. Our discussion will draw on existing and emerging insights from researchers and practitioners representing industrialized and developing regions of the world, including South America, Northern and Eastern Europe, and East Asia. We aim to identify knowledge gaps, research priorities to address these gaps, and opportunities for interdisciplinary and transnational learning and collaboration.



## Workshop 5: Measurement and experimental challenges in sleep related IAQ studies

Friday morning podium

Room 202B

Chairs: Jelle Laverge, Richard Corsi, Zhiwei Lian, Brandon Boor, Pawel Wargocki

In this workshop, we will integrate panel presentations and open group discussion to frame the basic methodological conditions for conducting experimental research in the emerging field of sleep IAQ. In doing so, we will provide guidance for replicating published and ongoing IAQ studies centered on the sleep microenvironment, ensuring results can be generalized and confirmed. There is a general lack of common experimental chamber methods and field measurement protocols in this emerging area of research. Therefore, it is very important to bring in input from different interdisciplinary research groups around the world that work in this field, alongside input from the general IAQ audience and IAQ practitioners and try to reach a consensus.

## Workshop 6: Ventilation and Transmission of Influenza and other Respiratory Viruses

Friday afternoon podium

Room 201A

Chairs: Donald Milton, Jelena Srebric

The role of ventilation in transmission of influenza is still unclear due to unknown environmental conditions at the time of actual flu virus transmission and an undefined role of the air-borne mode of transmission. This is true of influenza virus and even more so for other respiratory viruses. A major question is to identify workable epidemiologic study designs – can experimental infections and quarantine studies work? What are the obstacles to studies in nursing homes, college dorms, private homes? How can both the environment and outcomes be measured effectively? How can one control for confounding by other exposure sources, host immunity? This workshop is to consolidate the state-of-the-art of research methods and study designs to define the role ventilation plays in influenza transmission and transmission of other acute respiratory infections. Furthermore, the workshop is to explore future research avenues in addressing the knowledge gaps in our current understanding of the ventilation in flu transmission.

## Workshop 7: Translating sleep IEQ research into new residential ventilation standards

Friday afternoon podium

Room 202A

Chairs: Jelle Laverge, Brandon Boor, Pawel Wargocki, Zhiwei Lian, Atila Novoselac, Nuno Canha

We spend one-third of our lives sleeping. Poor IAQ and unsatisfactory thermal comfort in the bedroom and sleep microenvironment may play an important role in human health, sleep quality, and next-day performance. This workshop focuses on translating the latest sleep IAQ research into provisions for residential ventilation, bedroom-specific air purification, and thermal comfort standards. The themes include: particle exposure and air purification systems for bedrooms; local thermal comfort and bedding; noise; local sources and exhaled CO<sub>2</sub>; bedroom ventilation strategies.

## Workshop 8: Healthy building with the WELL building standard

Friday afternoon podium

Room 204C

Chairs: Atze Boerstra, Bjarne Olesen

The objective of this interactive workshop is to inform conference participants about the ins and outs of the WELL building standard, see [www.wellcertified.com](http://www.wellcertified.com) (especially the IAQ and thermal comfort aspects). One of the issues that will be addressed is the science behind the WELL criteria. During the interactive session at the end we - all participants together - will try to answer questions like 'are buildings with a WELL platinum score really healthier than average?' and 'are the right IAQ aspects addressed in WELL?'

## Other Special Sessions

### Growing up in IAQ

Tuesday and Thursday afternoon (16:30 – 17:30)

Room 201A

Chairs: Shelly Miller, Catherine Noakes

This session will be an interactive and informal experience with some of the newly elected ISIAQ Academy of Fellows as well as other accomplished and diverse indoor air experts. Presenters will make brief remarks on some of the highlights and lessons learned through out their careers. Then there will be plenty of time for questions and even hopefully some interesting answers! Come learn from others and share your own stories and experiences as you too have "grown up in IAQ."

This session will occur in two parts: part 1 on Tuesday afternoon and part 2 on Thursday afternoon, both in parallel with the latter half of the poster sessions scheduled at the same time.

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	<b>Air Cleaning and Filtration 1: Aerosol Filtration</b> Chairs: Alireza Afshari, Paolo Tronville Room 201B
Mon 7/23	10:30	219	Toward ideal surface filtration pressure drop modelling: the case using monodisperse spherical nanoparticles and PTFE HEPA media Author(s): Wanyi Zhang, Shiming Deng, Zhongping Lin
	10:45	597	Experimental study of a new hetero-caking filter with low pressure drop for efficient electrostatic filtration of ambient particulate matter Author(s): Enze Tian, Jinhan Mo
	11:00	572	Study on the Influence of Fiber Diameter on the Filtration Performance of Coarse Filter Author(s): Xin Zhang, Yuesheng Fan, Wei Xie, Hongli Zhang
	11:15	272	Comparisons of the different discharge performances and the effect of long-term loading with the liquid aerosol on electrets media Author(s): Yongxiang Wang, Wanyi Zhang, Zhongping Lin
	11:30	852	Do all particles get filtered equally? Effective particle removal for aerosol types exhibiting semivolatile behavior Author(s): Chunyi Wang, Michael Waring
	11:45	430	Integrity of DNA-Based Analysis of HVAC Filters from a Tropical Building Author(s): Irvan Luhung, Akira Uchida, William Nazaroff, Stephan Schuster

Day	Time	ID	<b>Building Simulation and CFD 1: Transport and Health</b> Chairs: Jelena Srebric, Twan Van Hooff Room 204B
Mon 7/23	10:30	128	A multi-constraints optimization to create a safe ventilation region in public buildings in response to random biochemical attacks Author(s): Lingjie Zeng, Jun Gao, Qiong Wang
	10:45	479	Numerical Assessment of a Novel Ventilation Strategy for Operating Rooms in Comparison with Turbulent Mixing and Laminar Air Flow Author(s): Cong Wang, Sasan Sadrizadeh
	11:00	377	Numerical Investigation of Contamination Transport in an Operating Theatre due to the Motion of a Circulating Nurse Author(s): Valeria Hofer, Hansjörg Rotheudt, Benjamin Zielke, Gerrid Brockmann, Martin Kriegel
	11:15	176	Air flow simulation for exhalation in the lower respiratory tract Author(s): Han Yu, Yuguo Li
	11:30	647	Impacts of Human Tracheal Cartilaginous Rings on Tracheobronchial Flow Structures Author(s): Mohammad Hossein Roozbahani, Mohammad Heidarinejad, Ghassem Heidarinejad
	11:45	702	Development of a Numerical Methodology to Assess Indoor Air Quality in Residential Buildings Author(s): Louis Cony, Marc Abadie, Olivier Ramalho

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Comfort, Productivity, and Perception 1: Productivity and Performance Chairs: Kwok Wai Tham, Bin Yang Room 201C
Mon 7/23	10:30	650	Investigating the link between indoor environment and workplace productivity in an office environment Author(s): Rajat Gupta, Alastair Howard
	10:45	665	Modeling Thermal Comfort and Performance Outcomes in 92 Finnish Office Buildings Author(s): Ulla Haverinen-Shaughnessy, Samy Clinchard, Salvatore Della Vecchia, Rick Aller, Tomas Novotny
	11:00	513	Effects of Activity-Based Workplace Design on Occupant Behavior and Productivity Author(s): Takuma Shinoyama, Shinichi Tanabe, Mikio Takahashi, Naoko Nozaki, Kazuki Wada, Hiroki Takahashi, Jun Nakagawa, Jun Shinoda, Akihiro Takimoto, Junichi Asaka
	11:15	409	Beneficial effects of physical activity in the office on workplace productivity Author(s): Kumika Seki, Toshiharu Ikaga, Koji Tanaka, Hiroaki Takai, Takuro Kikuchi, Kitoshi Tanaka, Megumi Nishida, Mikako Nishimura
	11:30	298	The effect of low ventilation rate on perceived air quality and work performance – A laboratory study Author(s): Henna Maula, Valtteri Hongisto, Annu Haapakangas, Hannu Koskela
	11:45	522	The effects of indoor carbon dioxide concentrations on arousal level and task performance Author(s): Toshihiro Otsuka, Masaru Itoyama, Masato Yano, Takafumi Maeda

Day	Time	ID	Concentrations and Exposure 1: Novel Approaches Chairs: Christopher Y. H. Chao, Corinne Mandin Room 204A
Mon 7/23	10:30	304	Quantifying the error of a low-cost particle monitor: common indoor residential aerosols Author(s): Philip Dacunto, Neil Klepeis, Kai-Chung Cheng, Viviana Acevedo-Bolton, Ruo-Ting Jiang, James Repace, Wayne Ott, Lynn Hildemann
	10:45	811	Investigating the role of hydrogen in the calibration of MOS gas sensors for indoor air quality monitoring Author(s): Caroline Schultealbert, Tobias Baur, Andreas Schütze, Tilman Sauerwald
	11:00	210	Evaluation of a Heated Graphite Scrubber for UV-Absorbance Measurements of Ozone Author(s): Peter Andersen, Andrew Turnipseed, Craig Williford, Chris Ennis, John Birks
	11:15	330	Assessing indoor air toxicity with condensate collected from air using the mitochondrial activity of human BJ fibroblasts and THP-1 monocytes Author(s): Heidi Salonen, Tuula Heinonen, Marika Mannerström, Mark Jackson, Maria Andersson, Raimo Mikkola, Jarek Kurnitski, Shahana Khurshid, Atila Novoselac, Richard Corsi
	11:30	373	Airborne toxicity of a non-ionic alcohol ethoxylate surfactant and wetting agent used in cleaning chemicals Author(s): Emmanuelle Castagnoli, Maria Andersson, Raimo Mikkola, Jarek Kurnitski, Heidi Salonen
	11:45	224	Indoor particle age, a new concept for improving the accuracy of estimating indoor airborne concentrations of semivolatile organic compounds (SVOCs) Author(s): Jianping Cao, Jinhan Mo, Zhiwei Sun, Yinping Zhang

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Sources and Emissions 1: Formaldehyde and VVOCs Chairs: Dustin Poppendieck, Hugo Destailhats Room 204C
Mon 7/23	10:30	216	A high-efficiency method for determining the formaldehyde emission characteristic parameters of building materials at different temperatures Author(s): Xiaojun Zhou, Yanfeng Liu, Xinke Wang, Fenghao Wang, Jiaping Liu
	10:45	227	Approach for avoiding multiple solution of measuring methods of characteristic parameters of formaldehyde/VOCs emitted from building materials Author(s): Xu Zhang, Jianping Cao, Jingya Wei, Yiping Zhang
	11:00	384	New methodology for determination of formaldehyde sorption rate constants for selected building materials of indoor surfaces Author(s): Alexandre Gross, Pierre Mocho, Herve Plaisance, Christophe Cantau, Natacha Kinadjian Caplat, Christophe Yrieix, Valérie Desauziers
	11:15	631	Evaluation of a Formaldehyde Reference Material for Small Chamber Emission Testing Author(s): Dustin Poppendieck, Wenhao Chen, Na Li, Wendy Galletta
	11:30	851	Formaldehyde Emissions from Seams and Cut Edges of Laminate Flooring: Implications for Emission Testing Protocols and Exposure Estimation Author(s): Wenhao Chen, Mark Mendell, Na Li, Kazukiyo Kumagai
	11:45	324	Concentrations of very volatile organic compounds (VVOCs) in wooden prefabricated houses Author(s): Alexandra Schieweck

Day	Time	ID	Symposium 1: Resilience and adaptation to environmental changes in buildings Chairs: Kazukiyo Kumagai, Vito Ilacqua Room 201A
Mon 7/23	10:30	739	Simulations of indoor air quality based on future climate conditions Author(s): Von Walden, Nathan Lima, Kevin Toombs, Amy Musser, William Kirk, Bertram Jobson, Brian Lamb
	10:45	722	Utilizing a Nationally Representative Model Set to Predict the Impacts of Climate Change on Energy Performance and IAQ in U.S. Residences Author(s): Torkan Fazli, Brent Stephens
	11:00	535	Factors Influencing Variations of PM Concentrations in Retrofitted Multifamily Buildings in Finland and Lithuania Author(s): Tadas Prasauskas, Dainius Martuzevicius, Liuliu Du, Darius Ciuzas, Virpi Leivo, Mihkel Kiviste, Ulla Haverinen-Shaughnessy
	11:15	673	Assessment of Radon Reduction Interventions with Energy Retrofits Author(s): Stacy Gloss, Paul Francisco, Jonathan Wilson, Ellen Tohn, William Rose, Yigang Sun, Sherry Dixon, Jill Breyse, David Jacobs
	11:30	246	Relationship between Resilience of Residences and Residents' Subjective Well-being Author(s): Ryota Sato, Toshiharu Ikaga, Shuzo Murakami, Tsuyoshi Seike
	11:45	212	Health Impacts of Home Energy Retrofits in Low-Income Residential Households Author(s): Prateek Shrestha, Shelly Miller, Jamie Humphrey, John Adgate, Elizabeth Carlton, Kelsey Barton, Elisabeth Root

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Symposium 2: Integrating ventilation and air cleaning for IAQ control in homes Chairs: Brett Singer, Jeffrey Siegel Room 203A
Mon 7/23	10:30	577	Ventilation and air cleaning in Korean multifamily residences Author(s): Dong Hwa Kang
	10:45	536	Developing health-based ventilation guidelines (HealthVent project) Author(s): Paolo Carrer, Eduardo de Oliveira Fernandes, Hugo Santos, Otto Hänninen, Stylianos Kephelopoulos, and Pawel Wargocki
	11:00	764	Are We Providing Effective Mechanical Ventilation in New US Homes? Author(s): Brett Singer
	11:15	231	How should ventilation and air cleaning be balanced in residences when ambient air quality is poor? Author(s): Yinping Zhang
	11:30	773	What are the limitations of filtration in the existing North American housing stock? Author(s): Jeffrey Siegel
	11:45	708	Reassessing Occupancy-Based Ventilation and IAQ in Homes Author(s): Iain Walker, Brennan Less

Day	Time	ID	Symposium 3: Explorations using distributed sensor networks to improve our understanding of the indoor environment and support practices that enhance health Chairs: Chenlu Zhang, Vivian Loftness, Brian Gilligan, Nicole Goebel, Chris Pyke, Kevin Kampschroer, Priya Premchandran, Lauren Riggs Room 202A
Mon 7/23	10:30	470	Sample Efficiency and Sensor Networks Author(s): Juan Palacios, Seema Bhangar, Chris Pyke, Nils Kok
	10:45	720	The Comparative Effect of Temperature and CO <sub>2</sub> on Work Performance Author(s): Chenlu Zhang, Vivian Loftness, Brian Gilligan, Nicole Goebel, Chris Pyke, Kevin Kampschroer, Priya Premchandran, Lauren Riggs
	11:00	257	Inhalation exposure to metabolic CO <sub>2</sub> and control interventions Author(s): Jovan Pantelic, Shichao Liu
	11:15	680	Learning Building Occupants' Social Interactions from Wearable and Stationary Ambient Sensing Systems Author(s): Ali Ghahramani, Jovan Pantelic, Casey Lindberg, Brian Gilligan
	11:30	338	Exploring the Influence of Relative Humidity on Human Health in Buildings Author(s): Brian Gilligan, Casey Lindberg, Kelli Canada, Bijan Najafi
	11:45	834	Expanding psychrometrics to enable humidity management through warm radiant comfort delivery Author(s): Forrest Meggers

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	Workshop 1: Aerosols: Life as Pig-Pen: Immersed in a Cloud of Particles and Microbes Chairs: Yilin Tian, Rachel Adams, Martin Täubel, Charles Weschler, Andrea Ferro, Brandon Boor Room 202B
<b>Mon 7/23</b>	10:30	Workshop
	10:45	
	11:00	
	11:15	
	11:30	
	11:45	

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Air Cleaning and Filtration 2: Photocatalysis and novel mechanisms Chairs: Jensen Zhang, William Fisk Room 201B
Mon 7/23	13:30	277	Efficiency assessment of a commercial photocatalytic coating to degrade NO under real-world conditions in an equipped experimental chamber Author(s): Julie Hot, Jivko Topalov, Barnabé Wayser, Erick Ringot, Alexandra Bertron
	13:45	462	The Performance of a Novel Nanofibrous TiO <sub>2</sub> Photocatalyst for the Decomposition of Toluene in Air Author(s): Dainius Martuzevicius, Ruta Sidaraviciute, Darius Ciuzas, Dalia Buivydiene, Edvinas Krugly
	14:00	279	A study on the valorization of titanium from chemical milling baths to design photocatalytic coatings for air depollution applications Author(s): Julie Hot, Ariane Dasque, Vanessa Mazars, Erick Ringot, Alexandra Bertron
	14:15	115	Control of bioaerosols in hospitals by high antimicrobial activity of silver nanoparticle synthesized by adsorption with chitosan- TiO <sub>2</sub> composite Author(s): Yen-Chi Chen, Kuo-Pin Yu, Wan-Tien Shen, Chian Su
	14:30	419	Phytoremediation of benzene from indoor air by ornamental plants Author(s): Yu Gong, Xiao Yu, Jing Yuan, Bin Xu
	14:45	515	Electrosorption of gaseous volatile organic compounds onto technical adsorbents Author(s): Mattia Pierpaoli, Gabriele Fava, Maria Letizia Ruello

Day	Time	ID	Building Simulation and CFD 2: Airflows and Methods Chairs: Catherine Noakes, Mohammad Heidarnejad Room 202A
Mon 7/23	13:30	278	Transport of Gaseous Pollutants from Underground Garage in High Residential Building under Mediterranean Climate Author(s): Yael Dubowski, Rivka Reichman
	13:45	833	Statistical Analysis of wind speed using K-means clustering Author(s): Yun Zhang, Sheng Wang, James Lo
	14:00	847	The diurnal cycle of urban thermal environment in street canyons by scale-model outdoor field measurement Author(s): Guanwen Chen, Yuguo Li, Qun Wang, Yuanyuan Lin, Jian Hang
	14:15	480	Performance of LES on non-uniform grids in a ventilated generic enclosure Author(s): Jo-Hendrik Thysen, Twan Van Hooff, Bert Blocken, Gertjan Van Heijst
	14:30	291	Discovery of environmental secrets for historical artefacts: how did micro-climate evolve in ancient tombs in initial phase Author(s): Jing Xiong, Angui Li, Changping Liu, Jungang Dong, Bin Yang, Tong Ren, Junji Cao
	14:45	839	Wind tunnel experiment and CFD simulation on pollutant inter-unit dispersion in U-type street canyons Author(s): Dongjin Cui, Gang Hu, Zhengtao Ai, Kenny Kwok, Cheuk-ming Mak



## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Comfort, Productivity, and Perception 2: Human Responses Chairs: John Spengler, Joon-Ho Choi Room 201C
Mon 7/23	13:30	112	Evaluation of Thermal Environment with Elevated Air Speed using a Breathing Thermal Manikin Author(s): Kuniaki Mihara, Bertrand Lastemas, Yuichi Takemasa, Kwok Wai Tham, Chandra Sekhar
	13:45	370	Thermal response and local thermal comfort of asymmetric radiant environment Author(s): Xiang Zhou, Maohui Luo, Yan Ren, Lili Zhang, Xu Zhang
	14:00	854	Local thermal discomfort caused by temperature stratification at whole-body thermal neutrality Author(s): Shichao Liu, Zhe Wang, Yingdong He, Maohui Luo, Hui Zhang, Stefano Schiavon
	14:15	247	The effects of elevated temperatures with high relative humidity on human responses Author(s): Xiaojun Fan, Weiwei Liu, Pawel Wargocki
	14:30	603	Effect of the Diversity Factor on the Indoor Air Quality Perception Author(s): Dolaana Khovalyg, Bjarne Olesen
	14:45	341	Sleep and Physiological Responses in Shelter-Analogue Settings during Winter Author(s): Kazuyo Tsuzuki, Yosuke Mochizuki, Kazuki Maeda, Yuki Nabeshima

Day	Time	ID	Concentrations and Exposure 2: Schools Chairs: Ulla Haverinen-Shaughnessy, Laura Kolb Room 204A
Mon 7/23	13:30	548	Distribution of 1000 free indoor air quality measurement kits to schools: kits as an alternative method proposed by the French regulation Author(s): Jessica Queron, Caroline Marchand, Virginie Migne, Camille Fevrier, Xavier Strebelle, Marc Durif
	13:45	750	Indoor particle concentrations in high school classrooms Author(s): Jianlin Ren, Michael Wade, Richard Corsi, Atila Novoselac
	14:00	808	Characterizing School Building Conditions & Related Impacts on Occupant Health, Safety & Well-Being, Utilizing A Combinational Crowd-Sourcing, Citizen-Science, & Sensor-Based Model Author(s): Jerry Roseman, Neil Roseman
	14:15	781	IAQ in High-Performance, Urban Schools: A Review Author(s): Emily Oldham, Hyojin Kim
	14:30	619	Indoor air quality in French schools: a nationwide study (2013-2017) Author(s): Claire Dassonville, Anthony Gregoire, Sivanantham Sutharsini, Bruno Berthineau, Mickael Derbez, Olivier Ramalho, Jacques Riberon, Corinne Mandin
	14:45	642	Research on the PM2.5 and CO2 concentrations of the Classrooms in Beijing Author(s): Chaorui Cai, Zhiwei Sun, Wei Xu, Yinping Zhang

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Symposium 4: What are the impacts of humans and their activities on indoor chemistry? (Sponsored by the Sloan Foundation) Chairs: Peter DeCarlo, Cora Young Room 201A
Mon 7/23	13:30	385	Interpreting time-resolved residential monitoring data to characterize emissions of volatile organic compounds from occupant activities Author(s): William Nazaroff, Yingjun Liu, Pawel Misztal, Jianyin Xiong, Yilin Tian, Caleb Arata, Allen Goldstein
	13:45	674	Indoor Oxidant Interplay: Illumination, Intrusion, and Immolation (Cooking) Author(s): Tara Kahan, Shan Zhou, Cora Young, Trevor Vandenoer, Shawn Kowal
	14:00	753	Third hand smoke contribution to indoor aerosol in a non-smoking classroom Author(s): Peter DeCarlo, Anita Avery, Michael Waring
	14:15	776	An overview and early results from the HOMEChem Indoor Air Chemistry Field Campaign Author(s): Marina Vance, Delphine Farmer, Atila Novoselac, Richard Corsi, Lea Hildebrandt Ruiz, Jonathan Abbatt, Peter DeCarlo, Philip Stevens, Tara Kahan, Allen Goldstein, William Nazaroff, Jose Jimenez, Paul Ziemann, Rob Knight, Pieter Dorrestein
	14:30	707	First high-time resolution HCl measurements indoors: Evidence for direct emission and indirect formation Author(s): Cora Young, Kathryn Dawe, Teles Furlani, Trevor Vandenoer, Shawn Kowal, Tara Kahan
	14:45	605	Aerosol-Phase Effects of Occupants on the Indoor Environment Author(s): Anita Avery, Michael Waring, Peter DeCarlo

Day	Time	ID	Symposium 5: Smart ventilation: Theory, applications, and case studies Chairs: Brent Stephens, Jelle Laverge, Brett Singer, Iain Walker, Andrew Persily Room 204B
Mon 7/23	13:30	171	Comparison of Different Image Processing Methods Used for a Webcam Based Occupancy Detection for Local Ventilation in a Lecture Hall Author(s): Gerrid Brockmann, Ibrahim El-Athman, Michael Klemke, Benjamin Zielke, Martin Kriegel
	13:45	691	Big data and DCV: smart ventilation? Author(s): Jelle Laverge
	14:00	746	Characterizing the natural ventilation potential of a building site using a neural network for spatial estimates of outdoor air quality Author(s): Brett Horin, Brent Stephens
	14:15	791	Alternative ventilation strategy using programmable exhaust fan controller Author(s): Susan Doll
	14:30	718	Development of a novel temperature-based demand controlled ventilation system for residential buildings Author(s): Joanna Polak, Klemen Rupnik, Alireza Afshari, Niels Bergsøe, Göran Hultmark
	14:45	528	Effects of Flush-out on the Reduction of VOCs in Newly Built Residential Buildings Author(s): Sang-In Park, Junseok Park

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Symposium 6: Indoor pollutants from emerging smoking and vaping devices: E-cigarettes, “reduced-risk” tobacco products and waterpipes Chairs: Hugo Destailats, Maciej Goniewicz Room 204C
Mon 7/23	13:30	662	Secondhand and Thirdhand Exposure to Nicotine and Particulates from Electronic Cigarettes Author(s): Zachary Dunbar, Lisa Kaiser, Eric Jensen, Mark Travers, Maciej Goniewicz
	13:45	389	Systemic Absorption of Nicotine and Indoor Air Pollution Following Secondhand Exposure to Electronic Cigarettes Author(s): Bartosz Koszowski, Meredith Thanner, Paul Melstrom
	14:00	517	Indoor air quality impact of chemical emissions from electronic cigarettes and heat-not-burn devices Author(s): Mohamad Sleiman, Xiaochen Tang, Jennifer Logue, V. Nahuel Montesinos, Lucia Cancelada, Marion Russell, Marta Litter, Neal Benowitz, Lara Gundel, Hugo Destailats
	14:15	779	Impact of Waterpipe Smoking on Indoor Air Quality Author(s): Mark Travers, Lisa Kaiser, Jubilee Prosser, Zachary Dunbar, Jessica Kulak
	14:30	745	Measuring Aerosol Particle Emissions from Cannabis Vaporization and Dabbing Author(s): Suzaynn Schick, Peter Jaques, Marley Zalay, Abel Huang, Kathryn Jee
	14:45	664	Volatilization and Partitioning to Particulate Matter of Deposited Electronic Cigarette Vapors Author(s): Erin Katz, Anita Avery, Peter DeCarlo

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session A: Air Cleaning and Filtration 1 (Chair: William Nazaroff)
Mon 7/23	15:30	113	Formaldehyde modelling of photocatalytic oxidation (PCO)-based applications in a building Author(s): Lexuan Zhong
	15:30	175	Nanofiber Filters with Low Air Resistance and the Potential Applications in Indoor Environments Author(s): Tongling Xia, Shanshan Shi, Chun Chen
	15:30	184	Improvement of PM10 and PM2.5 Concentration in Schools using Indoor Air Cleaners Author(s): Kwangchul Noh
	15:30	280	Botanical Biofiltration: Experimental Protocol and Method Author(s): Tatiana Armijos Moya, Andy Van Den Dobbelsteen, Marc Ottelé, Philomena Bluysen
	15:30	423	Facile in-situ synthesis of amorphous manganese oxides nanosheets on polyester fibers for formaldehyde decomposition at room temperature Author(s): Jinge Li, Pengyi Zhang
	15:30	469	Indoor Air Quality Solution for Commercial Buildings Author(s): Sean Menezes

Day	Time	ID	Poster Session B: Building Simulation and CFD 1 (Chair: Li Liu)
Mon 7/23	15:30	166	Analysis and Planning of Indoor Ventilation for Shrimp Farming Author(s): We-Mei Shih, Tzu-Ping Lin
	15:30	443	Indoor Air Quality Effect of Fan Surface on Dust in Fan Blade Rotating Author(s): Chih-Neng Hsu
	15:30	473	Particle Image Velocimetry Investigation for a Scaled Model of an Industrial Hall Author(s): Mihnea Sandu, Ilinca Nastase, Cristiana Croitoru, Florin Bode
	15:30	552	Can modeling tools be a reliable source of information on IAQ with only a limited set of data on the studied case? Author(s): Charles-Florian Picard, Marc Abadie, Karim Limam, Bénédicte Wall-Ribot, Thierry Duforestel, Abderrahman Elghazi
	15:30	556	Numerical investigation on the flow pattern of defeathering machines Author(s): Jianjian Wei, Yakun Liu, Tao Jin, Hui-Ling Yen, Yuguo Li
	15:30	562	Study on Numerical Simulation of Ice Removing System for EMU Train in China Author(s): Mingxin Liu, Jianlin Ren, Xingli Pu, Junjie Liu

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session C: Comfort, Productivity, and Perception 1 (Chair: Chungyoon Chun)
Mon 7/23	15:30	130	A real scene experiment to explore the influences of thermal experience on human thermal comfort Author(s): Wenjie Ji, Bin Cao, Yingxin Zhu
	15:30	403	Thermal balance of human body during sleep Author(s): Li Lan, Zhiqiang Zhai, Zhiwei Lian
	15:30	151	Field Evaluation of Indoor Air Quality and Thermal Comfort for a Library Building under Hot and Humid Climate Author(s): Fu-Jen Wang
	15:30	218	A model to predict bed microenvironment temperature and thermal comfort of sleeper Author(s): Nan Zhang, Bin Cao, Yingxin Zhu
	15:30	828	Analysis of Attributes of 10,000 US Houses Author(s): Carl Grimes
	15:30	262	Investigation on thermal comfort under the Air Carrying Energy Radiant air-conditioning System Author(s): Pei Peng, Guangcai Gong, Xiong Mei, Jia Liu
	15:30	265	Prediction of the human metabolic rate based on AI and the Kinect camera Author(s): Hooseung Na, Hoseong Kim, Hyeran Byun, Taeyeon Kim
	15:30	284	Field study of thermal comfort in a primary school under subarctic Sweden Author(s): Bin Yang

Day	Time	ID	Poster Session D: Comfort, Productivity, and Perception 2 (Chair: Brian Gilligan)
Mon 7/23	15:30	290	Changes in EEG signals at varying air temperature and relative humidity Author(s): Minghui Zhu, Weiwei Liu, Pawel Wargocki
	15:30	295	Study on the optimal temperature change pattern for sleep quality of people in the hot-humid area of China Author(s): Er Ding, Yufeng Zhang
	15:30	296	Study on the optimal air velocity change pattern for sleep quality of people in the hot-humid area of China Author(s): Er Ding, Yufeng Zhang
	15:30	318	Adaptive Environmental Comfort in Mixed Dormitories During Summer in Japan - Field Study Author(s): Vanya Draganova, Hiroki Yokose, Kazuyo Tsuzuki, Yuki Nabeshima
	15:30	344	A breath of fresh air: engaging students with air quality science in New Zealand schools Author(s): Mikael Boulic, Yu Wang, Robyn Phipps, Chris Chitty, Chris Cunningham, Alfred Moses, Ryan Weyers, Julian Jang-Jaccard, Gustavo Olivares, Aruna Shekar, Ian Longley, Lara Tookey, Agate Ponder-Sutton
	15:30	362	Fine Classification of “Hiesyo” Based on Differences in the Physiological and Psychological Responses between “Hiesyo” and “non-Hiesyo” Author(s): Yumiko Araki, Shinichi Tanabe, Mika Saito, Misa Imazu, Shinichi Kagiya, Tomoko Matsubasa, Moeko Tagawa, Chaichang Chen
	15:30	380	Research on Heat Stress of Construction Workers in Summer with High WBGTeff in Chongqing, China Author(s): Jiaze He

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session E: Concentrations and Exposure 1 (Chair: Elliott Gall)
Mon 7/23	15:30	29	Indoor Air Quality Study in the Carpentry Workshop at School of Construction and Environment at BCIT Author(s): John Cheng Law, Ranjodh Singh, Rohit Upadhyay, Rodrigo Mora
	15:30	135	Short-term Exposure to Volatile Organic Compounds for Passengers at Two Intercity Bus Terminals Author(s): Yu-Hsiang Cheng, Gu-Wei Yen, An-Chi Li
	15:30	137	Indoor Air Concentrations of Formaldehyde due to Emissions from Farm Polyethylene Plastic Film High Tunnels Author(s): Mehra Blott, Derek Shendell
	15:30	140	Role of Humidity and Interior Finish Materials on Particle Number Counts Author(s): Mawuena Quarcoo, Derek Shendell
	15:30	174	Simulation of indoor fine particulate dosimetry in a realistic human upper airway model based on the wildfire Author(s): Xiaoyu Xu
	15:30	190	Indoor Air Pollution at the Jerusalem Central Bus Station 2014-2017 Author(s): Geula Sharf
	15:30	263	A Study on the Determination of Main Factors to Consider in Radon Measurement in Residential Environments Author(s): Cheol Min Lee, Dae Ryong Kang, Tae Hyun Park, Si Hyun Park, Dan Gi Yoon, Hyung Jin Hong
	15:30	807	Personal exposure to ultrafine particles inside academic work environments in tropical climate Author(s): Lekshmi Mohan V, S M Shiva Nagendra, M Prakash Maiya

Day	Time	ID	Poster Session F: Concentrations and Exposure 2 (Chair: Seema Bhangar)
Mon 7/23	15:30	287	Different impacts of microenvironmental concentrations on personal exposures to PM10 and PM2.5 Author(s): Kiyong Lee, Yunhyung Hwang
	15:30	305	Indoor volatile organic compounds in Australia Author(s): Nigel Goodman, Anne Steinemann, Amanda Wheeler, Phillip Paevere
	15:30	310	Characteristics of indoor PM10 and PM2.5 concentrations in various microenvironments Author(s): Sooyoung Guak, Yunhyung Hwang, Kiyong Lee
	15:30	313	Assessment of hourly, daily and annually average indoor concentrations of outdoor originated PM2.5 predicted by the infiltration factor Author(s): Zhiwei Sun, Jianping Cao, Yinping Zhang
	15:30	327	Target list of volatile organic compounds based on field measurements in vehicle cabins Author(s): Wenjie Huang, Mengqiang Lv, Xudong Yang
	15:30	335	An Assessment of Building Condition in Nigerian Elementary Schools Author(s): Oluyemi Toyinbo, Richard Shaughnessy, Ulla Haverinen-Shaughnessy
	15:30	355	Indoor Air Quality in Shopping and Storage Areas Author(s): Laurence Robert, Romain Guichard, Corinne Mandin
	15:30	360	Volatile Organic Compound Exposure in Colorado Nail Salons Author(s): Aaron Lamplugh, Lupita Montoya

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session G: Sources and Emissions 1 (Chair: Glenn Morrison)
Mon 7/23	15:30	107	Impact of environmental factors on TVOC and odor emissions from alkyd resin enamel coating particleboard Author(s): Qifan Wang, Jun Shen, Tianyu Cao, Xiwei Shen
	15:30	108	VOCs Release Characteristics of Different Decorative Particleboards Author(s): Jiang Liqun, Jun Shen
	15:30	123	The influence of VOCs released by decorate particleboard on the environment under different loading rate Author(s): Shao Yali, Jun Shen, Tianyu Cao
	15:30	144	Use of a surface emissions trap for enhancing the indoor air quality Author(s): Lennart Larsson, Johan Mattsson
	15:30	155	Experimental study on the formaldehyde emission from indoor floor on the ground radiant heating system Author(s): Zhao Xiu, Wang Di
	15:30	187	The Primary Emissions of VOCs from Recycled Building Materials Author(s): Chi-Chi Lin, Yun-Tai Lee, Yu-Chun Lin, Huisan Chin
	15:30	204	Measurement of DEHP emission rates and transfer rates to particle from PVC sheet using PFS Author(s): Naohide Shinohara, Kanako Uchino
	15:30	821	Particle and PAH emissions from indoor candle lanterns Author(s): Adam Piotrowicz, Bernard Polednik, Marek Mardarowicz, Pawel Golianek, Marzenna Dudzinska

Day	Time	ID	Poster Session H: Sources and Emissions 2 (Chair: Tunga Salthammer)
Mon 7/23	15:30	221	Determination of VOC Residual in Dry Paint Film Author(s): Guoqing He, Jiechen Pan, Jiakui Jiang, Lihui Feng
	15:30	244	Predict Particle Deposition around the Cabin Air Supply Nozzles of Commercial Airplanes Author(s): Qing Cao, Chun Chen, Chao-Hsin Lin, Daniel Wei, Qingyan Chen
	15:30	293	Formaldehyde emission behaviour of wood based panels: application of a passive sampling for measuring the influence of decorative papers Author(s): Valérie Desauziers, Herve Plaisance, Christophe Yrieix
	15:30	463	A coupled heat, moisture and pollutants transport model for predicting VOC emissions from building materials under dynamic conditions of temperature and relative humidity Author(s): Anh Dung Tran Le, Nadège Blond, Cecile Caudron, Thierry Langlet
	15:30	381	Investigations on emission properties of VOCs from consumer products made of polymers Author(s): Morgane Even, Christoph Hutzler, Olaf Wilke, Bärbel Vieth, Andreas Luch
	15:30	404	A Double-exponential Model for Dynamic Emission of VOCs from Silicone Sealant Author(s): Junzhou He, Lv Mengqiang, Wenjie Huang, Xudong Yang
	15:30	864	Chemical emissions from products and materials: Analysis of formaldehyde and other VOCs in one sampling and analytical process Author(s): Natasha Spadafora, Caroline Widdowson, Nikhil Sahotra, Patricia Ballard

## Detailed Technical Program

Monday, July 23<sup>rd</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session I: Ventilation and HVAC Systems 1 (Chair: Chandra Sekhar)
Mon 7/23	15:30	120	Experiment investigation of a novel Air-Carrying Energy Radiant System Author(s): Guangcai Gong, Xiong Mei
	15:30	161	Energy efficiency of a fresh air handling system utilizing geothermal energy from the ground source heat exchanger Author(s): Lv Wh, Li Xianting
	15:30	173	The use of a 3D Sonic Anemometer for the Study of Airflow Patterns in a Hospital Patient Room Author(s): Chinmayee Patil, Elizabeth Cooper
	15:30	188	A Study on Ventilation Characteristic and HVAC Energy Consumption in Subway Author(s): Yue Zhang, Xiaofeng Li
	15:30	205	Measurement of the Heat Transfer Coefficients of Radiant Ceiling Panels Author(s): Jun Shinoda, Shinichi Tanabe, Hiroki Iwata
	15:30	102	Exposure Assessment and Ventilation Requirement Analysis for Indoor Air Pollutants in Non-Residential Buildings in China by Compiling the IAPub Database Author(s): Wei Ye, Hao Wang, Jun Gao, Xu Zhang
	15:30	163	The importance of air conditioning systems for the control of airborne particles in operating rooms Author(s): Marcelo Pereira, Rogério Vilain, Arlindo Tribess

Day	Time	ID	Poster Session J: Ventilation and HVAC Systems 2 (Chair: Nuno Canha)
Mon 7/23	15:30	349	Experimental analysis about the influence of the heat source distribution on the space cooling load when only the local zone is controlled Author(s): Chao Liang, Arsen Melikov, Xianting Li
	15:30	353	Exploration for the new set-point of Multi-Split Air Conditioning System in an Office in Summer Author(s): Emi Takai, Sayana Tsushima, Junta Fujisawa, Yuka Maruyama, Hiromasa Tanaka, Hiasataka Kitora, Shinichi Tanabe
	15:30	357	Ventilation Performance and Hygrothermal Conditions in New-build UK Housing Author(s): Gráinne McGill, Tim Sharpe, Lynette Robertson, Rajat Gupta, Ian Mawditt
	15:30	429	Study on Indoor Environment Simulation and Field Test of A Large Transparent-Roof Building Author(s): Haitian Zhao, Borong Lin, Jinghua Zhang
	15:30	457	The Impact of Ventilation System Operation on The Dynamics of Bioaerosols in Tropical Buildings Author(s): Boon Yuean Lim, Akira Uchida, Irvan Luhung, Kenny Jia Xu Lau, Stephan Schuster
	15:30	582	Joint Operation Strategy of HVAC System and Air Cleaner in Shopping Mall Author(s): Fanbing Zeng
	15:30	589	Analyse the effect of various residential dwelling ventilation modes on IAQ based on long-term monitoring-Tianjin Author(s): Lei Zhao, Junjie Liu
	15:30	602	A study on mechanical ventilation in residential buildings in Tianjin Author(s): Zifan Wu, Hejiang Sun



## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Air Cleaning and Filtration 3: Formaldehyde Chairs: Mark Jackson, Jason Ham 201B
Tues 7/24	10:30	339	Testing formaldehyde removal capacities of sorption-based portable air cleaners in the field and laboratory Author(s): Xiaoyue Zhu, Mengqiang Lv, Xudong Yang
	10:45	436	A Thermal-regenerated Laminated Air Purification Module for Indoor Formaldehyde Removal Author(s): Ru Xiao, Jinhan Mo
	11:00	442	Rapid adsorption/reaction of flexible MnO <sub>2</sub> /Carbon electro-thermal textile for the abatement of indoor formaldehyde Author(s): Jinlong Wang
	11:15	644	Effective removal of indoor formaldehyde: an electric-thermally regenerated slice coated with activated carbon Author(s): Hongyin Chen, Jinhan Mo, Ru Xiao
	11:30	855	Adsorption Performance of Formaldehyde on Modified Activated Carbon Author(s): Lisha Sheng, Zhenqian Chen
	11:45	524	Formaldehyde emissions from residential fiberglass HVAC filters Author(s): Hugo Destailats, Marion Russell, William Fisk

Day	Time	ID	Comfort, Productivity, and Perception 3: Green Buildings and Social Housing Chairs: Hyojin Kim, John Spengler Room 201C
Tues 7/24	10:30	803	The comparison of thermal discomfort between a typical office and a green building office Author(s): Suh-Hyun Kwon, Yoonhee Lee, Chungyoon Chun
	10:45	705	Reporting from the Field: Pre/Post-Occupancy Assessment of Thermal Comfort and Indoor Air Quality Performance of a LEED® Double-Platinum Commercial Office Building Author(s): Stanley Gatland, Ihab Elzeyadi, Ying Wang
	11:00	770	Prevalence of building features with possible impacts on student outcomes in LEED-certified schools Author(s): Donna Vakalis, Jeffrey Siegel, Heather Maclean
	11:15	774	Indoor Environmental Quality Assessment of a Net-Zero Energy Office Building in a Mixed-Humid Climate Author(s): Hyojin Kim, Majd Hijazi
	11:30	270	Perceived indoor environment quality in energy-efficient dwellings Author(s): Mickael Derbez, Eline Le Ponner, Laetitia Malingre, Olivier Ramalho, Jacques Riberon, Corinne Mandin
	11:45	689	Evaluation of the Perceived Indoor Environment before and after Renovation of Social Housing Author(s): Henrik N. Knudsen, Tine Steen Larsen

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Concentrations and Exposure 3: Formaldehyde Chairs: Richard Corsi, Nicholas Clements Room 204A
Tues 7/24	10:30	95	Accuracy of Three Types of Formaldehyde Passive Samplers Author(s): Francis Offermann
	10:45	390	Formaldehyde passive sampler using an optical chemical sensor: design optimization to limit humidity interference Author(s): Jane Vignau-Laulhere, Pierre Mocho, Herve Plaisance, Katarzyna Raulin, Thu-Hoa Tran-Thi, Valérie Desauziers
	11:00	794	Diurnal Formaldehyde Concentrations in High Schools Author(s): Michael Wade, Leigh Lesnick, Neil Crain, Atila Novoselac, Richard Corsi
	11:15	233	Formaldehyde concentrations and air exchange rates in European housings Author(s): Tunga Salthammer
	11:30	503	Performance Validation of Real-time Formaldehyde Sensors through Lab Testing and in a Real Building Author(s): Ying Wang, Stanley Gatland, Valerie Goletto, Chuck Fisher, Isabelle Lesieur, Genevieve Mialon, Jerome Gilles, Nicolas Drolet
	11:45	248	Characteristics and inhalation cancer risks assessment of exposure to VOCs in 20 asthmatic children's homes in Shanghai Author(s): Lin Fang

Day	Time	ID	Microbiology and Dampness 1: Field Studies Chairs: Miia Pitkäranta, Hal Levin Room 204C
Tues 7/24	10:30	516	The Microbiome of Settling Dust from Childcare Centres in Singapore Author(s): Akira Uchida, Irvan Luhung, Dana Miller, Sandra Kolundzija, Cassie Heinle, Kenny Jia Xu Lau, Premkrishnan Vasantha, Ganatri Sankaran, Ron Tan, Stephan Schuster
	10:45	150	Characterization of biological contaminants in 50 elementary schools in a large city Author(s): Ju-Hyeong Park, Michael Sulyok, Steve Game, Jerry Roseman, Jean Cox-Ganser
	11:00	731	Spatial and longitudinal influences on accurately predicting a microbiome "biofingerprint" Author(s): Christopher Stamper, Andrew Hoisington, Katherine Bates, Maggie Stanislawski, Michael Flux, Kenneth Krauter, Christopher Lowry
	11:15	235	Seasonal Dynamics of DNA and RNA Viral Bioaerosol Communities in a Daycare Setting Author(s): Aaron Prussin II, Pedro Torres, John Shimashita, Steven Head, Scott Kelley, Linsey Marr
	11:30	716	Longitudinal assessment of the influence of lifestyle homogenization on the microbiome in a cohort of United States Air Force Cadets Author(s): Anukriti Sharma, Miles Richardson, Lauren Cralle, Christopher Stamper, Juan Maestre, Kelly Stearns-Yoder, Katherine Bates, Kerry Kinney, Lisa Brenner, Christopher Lowry, Andrew Hoisington, Jack Gilbert
	11:45	685	Microscopic roommates: The biological sources of indoor air bacteria of single-family homes in Portland, Oregon Author(s): Sue Ishaq, Roo Vandegrift, Jeff Kline, Ashkaan Fahimipour, Jason Stenson, Ryann Crowley, Hannah Wilson, Dale Northcutt, Erica Hartmann, Deb Johnson-Shelton, G.Z. Brown, Jessica Green, Kevin Van Den Wymelenberg

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Ventilation and HVAC Systems 1: Specialized Spaces and Controls Chairs: Andrew Persily, Catherine Noakes Room 204B
Tues 7/24	10:30	261	Measured pollutant removal performance of range-integrated downdraft exhaust kitchen ventilation device Author(s): Jordan Clark, Iain Walker, Gabriel Rojas
	10:45	294	Study on influences of ventilation on humidity and carbon dioxide concentration at a kindergarten during winter Author(s): Junpei Koyasu, Tetsu Aoki, Mine Sudo
	11:00	532	An overview of indoor air quality and ventilation standards in commercial buildings and aircrafts Author(s): Erica Zavaglio, Mathieu Le Cam, Giusi Quartarone, Catherine Thibaud
	11:15	633	Ventilation rates and determinants in California classrooms after HVAC efficiency retrofits Author(s): Xiwang Li, Wanyu Chan, Brett Singer
	11:30	789	Uncertainty Analysis of Various CO <sub>2</sub> -Based Methods for Estimating Ventilation Rates in Occupied and Unoccupied Classrooms Author(s): Josephine Lau, Adel Kabirikopaei
	11:45	651	Semantic Frameworks for Model-based Assessment and Management of Indoor Air Quality Author(s): Parastoo Delgoshaei, Mohammad Heidarinejad, Mark Austin

Day	Time	ID	Symposium 7: MOCCIE: first results from a new modelling consortium for indoor air chemistry (Sponsored by the Sloan Foundation) Chairs: Nicola Carslaw, Manabu Shiraiwa Room 201A
Tues 7/24	10:30	213	Atomistic molecular dynamics simulations of uptake and transport processes in systems relevant to indoor air chemistry Author(s): Douglas Tobias
	10:45	492	Computational Fluid Dynamics (CFD) simulation of primary and secondary ozone reactions associated with human surfaces Author(s): Donghyun Rim, Youngbo Won
	11:00	337	Evaluating different methods of estimating vapour pressures for predicting gas-to-particle phase partitioning Author(s): Magdalena Kruza, Michael Waring, Ray Wells, Nicola Carslaw
	11:15	477	The impact of clothing on squalene ozonolysis products in skin and indoor environments Author(s): Pascale Lakey, Glenn Morrison, Manabu Shiraiwa
	11:30	149	Dermal uptake from clothing of SVOCs not removed by laundering Author(s): Glenn Morrison, Charles Weschler, Gabriel Bekö
	11:45	600	Understanding the Impact of Chemical Aging on Indoor Secondary Organic Aerosol Using the 2D Volatility Basis Set Author(s): Bryan Cummings, Michael Waring

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Symposium 8: Improving IEQ in schools: the positive health impacts on school community Chairs: Ulla Haverinen-Shaughnessy, Richard Shaughnessy Room 202A
Tues 7/24	10:30	829	Baseline IEQ measurements in a school district-imposed intervention based on a massive district-wide renovation project Author(s): Richard Shaughnessy, Mark Hernandez, Ulla Haverinen-Shaughnessy
	10:45	830	Assessing Effects Of District Wide Renovation Program On Students' Absenteeism: Baseline Data Author(s): Ulla Haverinen-Shaughnessy, Richard Shaughnessy, Wanda Phipatanakul
	11:00	142	Retrofit of school ventilation and pupil well-being and performance – ASHRAE RP1624 Author(s): Jorn Toftum, Pawel Wargocki
	11:15	596	A study on cleaning effectiveness in schools and students' absence Author(s): Ulla Haverinen-Shaughnessy, Richard Shaughnessy
	11:30	136	Reducing Classroom Temperatures in a Tropical Climate Improved the Performance of Elementary School Pupils Author(s): Jose Ali Porras-Salazar, Pawel Wargocki, Beatriz Piderit-Moreno
	11:45		Discussion and summary

Day	Time	ID	Symposium 9: Smart Technologies for Enhancing IEQ Chairs: Kwok Wai Tham, Benjamin Hanoune, Horace Mui, Rukshala Anthon Room 202B
Tues 7/24	10:30	546	Smart Technologies and Indoor Environmental Quality: A Symbiosis? Author(s): Kwok Wai Tham
	10:45	733	A low-cost user-friendly indoor environmental quality (IEQ) calculator for monitoring poor living environment Author(s): Horace Mui, Ling Tim Wong, Tsz Wun Tsang
	11:00	410	Developments in multisensor monitoring of indoor air quality Author(s): Benjamin Hanoune
	11:15	565	Sensed data for optimizing IEQ and energy consumption of a floor in a Tropical Building Author(s): Junjing Yang, Yuan Luo, Kwok Wai Tham, Dionysia Kolokotsa, Prashant Anand
	11:30	547	A Wireless Sensor-Actuator Network for Enhancing IEQ Author(s): Kwok Wai Tham, Arun Kumar, Balaji Kalluri, Sanjib Panda
	11:45		Discussion and summary

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Symposium 10: Natural Ventilation in China: Dilemma between Energy Use and Indoor Air Quality: Part 1 Chairs: Tengfei Zhang, Junjie Liu Room 203A
Tues 7/24	10:30	118	Overview of the National Key R&D Project on Strategies for Improving Ventilation and Indoor Air Quality in Chinese Residential Buildings Author(s): Qingyan Chen
	10:45	623	Pollution in Chinese homes: how serious is it? Author(s): Xilei Dai, Xiangdong Li, Junjie Liu, Yihui Yin, Jingjing Pei, Yuexia Sun
	11:00	153	Is oil temperature a key factor deciding PM2.5 emission from Chinese cooking? Author(s): Yuejing Zhao
	11:15	289	Contribution of different ozone sinks to indoor ozone level in residential buildings in China Author(s): Mingyao Yao, Bin Zhao
	11:30	122	How Many Surrounding Buildings Should be Included in Simulating Wind Flow around a Building? Author(s): Sumei Liu, Wuxuan Pan, Hao Zhang, Xionglei Cheng, Zhengwei Long, Qingyan Chen
	11:45		Discussion and summary

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	<b>Comfort, Productivity, and Perception 4: IEQ</b> <b>Chairs: Bin Yang, Shichao Liu</b> <b>Room 201C</b>
<b>Tues 7/24</b>	13:30	206	Occupant response to controllable LED lighting Author(s): Jorn Toftum, Anders Thorseth, Jakob Markvart, Astá Logadottir
	13:45	297	Noise annoyance from road traffic in Finland Author(s): Henna Maula, Valtteri Hongisto, Pekka Saarinen
	14:00	715	Visual environmental qualities associated with occupant satisfaction in multiple office buildings Author(s): Young Joo Son, Azizan Aziz, Vivian Loftness
	14:15	729	Investigation of a real-time change of human eye pupil sizes for visual environmental controls in the workplace environment Author(s): Joon-Ho Choi, Xiaoxin Lin, Marc Schiler
	14:30	564	Emission measurements of VOCs from third-hand smoke and the correlation with the odor intensity Author(s): Miyuki Noguchi, Akihiro Yamasaki
	14:45	560	Mold odor - method for controlled exposure to very low levels of 2,4,6-trichloroanisole suitable for determination of odor thresholds Author(s): Stephanie Juran, Lena Ernstgård, Gunnar Johanson, Johnny Lorentzen

Day	Time	ID	<b>Concentrations and Exposure 4: Influences from Outdoors</b> <b>Chairs: William Nazaroff, Lance Wallace</b> <b>Room 204A</b>
<b>Tues 7/24</b>	13:30	165	Estimating PM2.5 penetration factors and deposition rates in a dwelling using a combined blower-door test Author(s): Yonghang Lai, Peter Brimblecombe, Ian Ridley
	13:45	393	Using improved methods to measure the transport of outdoor ozone and fine and ultrafine particulate matter into residential buildings Author(s): Haoran Zhao, Brent Stephens
	14:00	526	Ultrafine particle penetration from outdoor to indoor environments Author(s): Chen Chen, Bin Zhao
	14:15	699	Indoor-to-outdoor particle concentration assessment for human exposure analysis Author(s): S. Marta Almeida, Tiago Faria, Vânia Martins, Nuno Canha, Inês Cunha-Lopes, Carolina Correia, Evangelia Diapouli, Manousos-Ioannis Manousakas, Konstantinos Eleftheriadis
	14:30	476	Indoor/Outdoor Relationships and Anthropogenic Elemental Signatures in Airborne PM2.5 at a High School: Impacts of Petroleum Refining Emissions on Lanthanoid Enrichment Author(s): Shankar Chellam, Ayse Bozlaker, Jordan Peccia
	14:45	211	Impacts of Wildfire and Traffic-Related Air Pollution on Indoor Air Quality of Low-Income Residential Households in Colorado, USA Author(s): Prateek Shrestha, Shelly Miller, Jamie Humphrey, John Adgate, Elizabeth Carlton, Elisabeth Root

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Ventilation and HVAC Systems 2: Energy and Controls Chairs: Yuguo Li, Simi Hoque Room 204B
Tues 7/24	13:30	420	Energy-efficient control of a novel VAV ventilation system with decentralized fans: Full-scale experimental study in a building Author(s): Samira Rahnema, Alireza Afshari, Niels Bergsøe
	13:45	514	Implications of temperature-based and occupancy-based control of a Variable Air Volume (VAV) air-conditioning system serving multiple zones Author(s): Chandra Sekhar, Prashant Anand, David Cheong
	14:00	558	Human Responses in a Simulated Mixed-mode Building with Moderately Cool Temperature Author(s): Hitoshi Nagatsugu, Pawel Wargocki
	14:15	347	Heat Load and Indoor Environment under the Combined Use of Radiant Cooling System and Active Chilled Beam Author(s): Ryoya Furukawa, Jun Shinoda, Shinichi Tanabe, Hiroki Iwata, Misa Imazu, Sayana Tsushima
	14:30	586	Long Term Performance of Air to Air Enthalpy Exchanger under Danish Climate conditions Author(s): Abdul Manan, Ahsan Iqbal, Alireza Afshari, Niels Bergsøe

Day	Time	ID	Microbiology and Dampness 2: Bacterial and Fungal Growth Chairs: Tiina Reponen, Pertti Pasanen Room 201B
Tues 7/24	13:30	520	Comparison of two test methods to assess the resistance of bio-based insulation materials against moulds Author(s): Ana Maria Tobon Monroy, Yves Andres, Nadine Locoge
	13:45	628	Microbial Community and Metabolic Succession on Common Building Materials under High Relative Humidity Conditions Author(s): Cesar Cardona, Simon Lax, Dan Zhao, Daniel Raba, Gabriel Goodney, Peng Gao, Neil Gottel, Erica Hartmann, Paul Thomas, Scott Kelley, Brent Stephens, Jack Gilbert
	14:00	749	The influence of material chemical composition on microbial dynamics of wetted building materials Author(s): Dan Zhao, Daniel Raba, Cesar Cardona, Neil Gottel, Valerie Jean, Winton, Scott Kelley, Jack Gilbert, Brent Stephens
	14:15	756	Mathematical model simulating fungal and bacterial growth on surfaces in indoor spaces Author(s): Shamia Hoque, Dahae Seong
	14:30	639	Assessment of the mould contamination in efficient-energy dwellings through the Fungal Contamination Index Author(s): Mickael Derbez, Eline Le Ponner, Stephane Moularat, Rukshala Anton, Olivier Ramalho, Jacques Riberon, Corinne Mandin
	14:45	334	Ventilation, Thermal Comfort and Cleanliness of High Contact Surface in Nigerian Schools Author(s): Oluyemi Toyinbo, Chiagoziem Obi, Richard Shaughnessy, Ulla Haverinen-Shaughnessy

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Sources and Emissions 2: 3D Printers and Consumer Products Chairs: Christopher Y. H. Chao, Elisa Van Kenhove Room 204C
Tues 7/24	13:30	356	Emissions from consumer fused deposition modelling 3D printers and their potential health impact Author(s): Rodney Weber, Qian Zhang, Aika Davis, Marilyn Black
	13:45	372	Characterization of Particles and Volatile Organic Compounds Emitted during the Operation of a 3D-Printer Author(s): Erik Uhde, Jianwei Gu, Tunga Salthammer
	14:00	661	Chemical and Physical Characterization of 3D Printer Aerosol Emissions with the Aerosol Mass Spectrometer Author(s): Erin Katz, Doug Goetz, Chunyi Wang, Brandon Terranova, Michael Waring, Peter DeCarlo
	14:15	519	Targeting off-odors in toys and children's products: From identifying substances to characterizing emissions Author(s): Christoph Wiedmer, H�el�ene Meng, Jonathan Beauchamp, Andrea Buettner
	14:30	814	Characterization of Three Scent Diffusers using d-Limonene Author(s): Nicholas Clements, Sara Aristizabal, Shaun Ly

Day	Time	ID	Symposium 11: Frontiers in indoor air chemistry (Sponsored by the Sloan Foundation) Chairs: Nicola Carslaw, Ray Wells Room 201A
Tues 7/24	13:30	345	Public engagement opportunities for the indoor air community Author(s): Nina Notman
	13:45	121	Exploration of the Influence of Amines on Secondary Organic Aerosol Formation Author(s): Ray Wells, Joel Harrison, Jason Ham, Stephen Jackson
	14:00	667	The role of organic fraction of aerosol particles in uptake of indoor SVOC investigated with real time aerosol mass spectrometry Author(s): Axel Eriksson, Christina Andersen, Annette Kraus, Jacob N�jgaard, Per-Axel Clausen, Joakim Pagels, Aneta Wierzbicka
	14:15	208	Insights on the Multiphase Chemistry of Indoor Trace Gases and Aerosols Author(s): Douglas Collins, Rachel Hems, Shouming Zhou, Chen Wang, Masih Alavy, Jeffrey Siegel, Jonathan Abbatt
	14:30	225	Comparison of the Oxidative Potential of Size Segregated Aerosols of Ambient Origin in Indoor and Outdoor Environments Author(s): Haoran Yu, Haoran Zhao, Brent Stephens, Vishal Verma
	14:45	713	Identification of Sources of Trace Gases in an Art Museum using Mass Spectrometry and Positive Matrix Factorization Author(s): Derek Price, Demetrios Pagonis, Lucas Algrim, Anne Handschy, Shelly Miller, Douglas Day, Joost De Gouw, Paul Ziemann, Jose Jimenez



## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Symposium 12: Computational Fluid Dynamics (CFD) modeling of indoor pollutant transport and human exposure Chairs: Donghyun Rim, Li Liu Room 202A
Tues 7/24	13:30	395	Computational Fluid Dynamics simulations of Personalised Ventilation: Sampling air quality in the breathing zone Author(s): Natalie Gilkeson, Amirul Khan, Catherine Noakes
	13:45	686	Investigations on the convective thermal plume around the head of the standing and lying human body Author(s): Laurentiu Tacutu, Ilinca Nastase
	14:00	554	Distribution pollutants from exhaled jet in stratified environment Author(s): Hua Qian, Chongyang Zhang, Xiaohong Zheng, Haigang Ren
	14:15	254	3D RANS CFD simulations of gaseous pollutant transport in generic enclosures: two case studies Author(s): Twan Van Hooff, Bert Blocken
	14:30	684	Coupling a Building Model to an LES Tool to Study Indoor Effects of an Outdoor Contaminant Author(s): Michael Sohn, Paul Bieringer, Harmen Jonker, Aaron Pina, David Lorenzetti
	14:45	846	CFD and Wind Tunnel studies of Flow Patterns and Turbulent Characteristics in Idealized 2-D Deep Street Canyon with various Reynolds Numbers Author(s): Yuanyuan Lin, Mats Sandberg, Lan Chen, Jian Hang, Cuiyun Ou

Day	Time	ID	Symposium 13: Natural Ventilation in China: Dilemma between Energy Use and Indoor Air Quality: Part 2 Chairs: Jingjin Pei, Qingyan Chen Room 203A
Tues 7/24	13:30	446	Natural ventilation in China: the state-of-the-art Author(s): Yuexia Sun
	13:45	323	Modeling of volatile organic compounds transport in buildings: A case study in the field Author(s): Mengqiang Lv, Xiaoyue Zhu, Xudong Yang
	14:00	199	Optimal ventilation for Chinese homes when simultaneously considering indoor and outdoor pollution Author(s): Zhou Su, Tengfei Zhang, Shugang Wang
	14:15	488	IAQ Impacts of Natural vs. Mechanical Ventilation with Filtration in a Home in Shenzhen China Author(s): Ximing Chen, Bowen Liu, Yao Gao, Jun Ren
	14:30		Discussion and summary
	14:45		

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	Workshop 2: Measuring Ventilation in IAQ Studies of Schools: Challenges and Solutions? (STC 21) Chairs: Richard Shaughnessy, Andrew Persily, Stuart Batterman
Tues 7/24	13:30	Workshop
	13:45	
	14:00	
	14:15	
	14:30	
	14:45	

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session A: Air Cleaning and Filtration 2 (Chair: Parham Azimi)
Tues 7/24	15:30	506	Secondary Particle Emission from Used Fibrous Filters Author(s): Lili Ji, Jingjing Pei, Chuanbin Dong
	15:30	518	Transparent electrospun PLA-nanofibers on 3D-printed honeycomb for a high-efficient air filtration Author(s): Mattia Pierpaoli, Luca Riderelli, Silvia Palmieri, Maria Letizia Ruello, Gabriele Fava
	15:30	569	Photocatalytic oxidation of Acrylonitrile: A study of the influence of operating parameters Author(s): Henrietta Whyte, Cécile Raillard, Valerie Héquet, Albert Subrenat, Yves Andres
	15:30	590	Using metal foams as collecting electrodes in electrostatic precipitator for efficient removal of ambient particles Author(s): Enze Tian, Jinhao Mo
	15:30	635	Numerical Analyses of the Applicability of Façade Integrated Electrostatic Precipitators in Naturally Ventilated Residential Buildings Author(s): Dong Hwa Kang, Ye Seul Eom, Dong Hee Choi
	15:30	638	Advances in Aircraft Cabin Air Filtration Author(s): Marilena Dinca, Paul Roux, Steve Simpson
	15:30	416	Atomically Pt implanted nanoporous TiO <sub>2</sub> film with exposed {001} facets for efficient simultaneous removal of low concentration toluene and ozone Author(s): Hong Zheng, Pengyi Zhang, Tongzhou Xu
	15:30	567	A study on electrolytic dehumidification with proton exchange membrane at different temperatures for air-conditioning systems Author(s): Dajuan Li, Ronghui Qi, Li-Zhi Zhang

Day	Time	ID	Poster Session B: Building Simulation and CFD 2 (Chair: Jovan Pantelic)
Tues 7/24	15:30	591	Discussions on three methods of modelling fabric air dispersion system without orifices in CFD simulation Author(s): Fu Jiang Chen
	15:30	626	A case study on fresh air Mechanical ventilation system in a residential building of Tianjin Author(s): Xueting Wang, Hejiang Sun
	15:30	721	Simulation of indoor air flow and particle concentration distribution using lattice Boltzmann method Author(s): Sang Bok Kim, Dong Keun Song
	15:30	780	Balanced Pressure Low Velocity Space Conditioning Author(s): Mark Luther
	15:30	815	Initial mesh set up in CFD modeling for accuracy in air changes per hour Author(s): Prudsamon Kammasorn
	15:30	844	Wind Driven Natural Ventilation Flow Rate Estimation by Using Virtual Wind Tunnel Simulation in CFD Author(s): Sheng Wang, James Lo, Yun Zhang
	15:30	867	Legionella pneumophila on tap: optimising design of domestic hot water systems using building energy simulation Author(s): Elisa Van Kenhove, Matthias Van Hove, Arnold Janssens, Jelle Laverge

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session C: Chemistry and Transformations 1 (Chair: Pertti Pasanen)
Tues 7/24	15:30	425	Impact of green roof surfaces on O <sub>3</sub> levels near building ventilation supply Author(s): Pradeep Ramasubramanian, David Pleshakov, Samuel Salin, Olyssa Starry, Todd Rosenstiel, Elliott Gall
	15:30	438	Quantitative detection method of semiquinone radicals absorbed on particulate matters Author(s): Ru Xiao, Jinhan Mo, Luyang Wang
	15:30	498	Reaction between ozone and limonene under reduced pressure conditions simulating an aircraft cabin environment Author(s): Atsushi Mizukoshi, Kenichi Azuma, Shigehiro Sugiyama, Daisuke Tanaka, Masashi Inoue, Masahiro Tokumura, Jiro Okumura
	15:30	525	Indoor-outdoor connection of PM <sub>2.5</sub> constituents Author(s): Cong Liu
	15:30	544	Experimental study on DEHP adsorption characteristics onto airborne fine and coarse particles Author(s): Naoki Kagi, Yuka Tanaka
	15:30	601	Photocatalytic paints: improving a new binder to reduce VOCs emissions Author(s): Adrien Gandolfo, Julien Morin, Brice Temime-Roussel, Henri Wortham, Sasho Gligorovski
	15:30	868	Analysis of Particulate Phase Squalene-Ozone Reaction By-Products Author(s): Breann Coffaro, Clifford Weisel
	15:30	871	Initial studies on the photosensitized chemistry of nitrogen oxides Author(s): Stephanie Jones, Heather Schwartz-Narbonne, James Donaldson

Day	Time	ID	Poster Session D: Comfort, Productivity, and Perception 3 (Chair: Pawel Wargocki)
Tues 7/24	15:30	399	Designing an Individually Controlled System based on children's' perception and preferences of IEQ in a classroom Author(s): Dadi Zhang, Philomena Bluysen, Martin Tenpierik
	15:30	534	Sleep quality and Thermal environment in Bedrooms in Malaysia Author(s): Kazuyo Tsuzuki, Ikue Mori
	15:30	439	Indoor Thermal Environment Control Based on Thermal Sensations Predicted by Smart Wrist Band Author(s): Dianshan Han, Fulin Wang, Ruiting Wang, Ziyang Gong, Wenhong Yu
	15:30	138	Characterizing Farm Polyethylene Plastic Film High Tunnels Indoor Air Environmental Quality Measures Author(s): Mehra Blott, Derek Shendell
	15:30	467	Impact of moisture buffering capacity of interior objects on hygrothermal performance and perception of indoor air quality in a room Author(s): Anh Dung Tran Le, Omar Douzane, Geoffrey Promis, Anh Tuan Nguyen, Laurent Lahoche, Thierry Langlet
	15:30	505	Can simulated natural wind provide a better-differentiated air perception? Author(s): Minjung Kim, Jieun Han, Jeongseo Lee, Chungyoon Chun
	15:30	510	Human thermoregulatory responses during sleep Author(s): Jinping Zhao, Binkan Zhou, Yufeng Miao, Linjing Deng, Qihong Deng

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session E: Concentrations and Exposure 3 (Chair: Corinne Mandin)
Tues 7/24	15:30	466	Respirable particulate matter within residential homes in two South African communities, 2016-2017 Author(s): Brigitte Language
	15:30	806	The effects of temperature and relative humidity on PM2.5 light-scattering sensor instrument (FS-AIR 1.0) Author(s): Yunfei Cai, Wenming Shi, Zhuohui Zhao, Qinchen Chen
	15:30	508	Evaluation of Utilization on Indoor Air Quality Sensors Based on Internet of Things (IoT) Author(s): Na-Na Jeong, Hye-Won Lee, Ji-Hoon Seo, Jong-Ryeul Sohn
	15:30	523	Formaldehyde and TVOCs sensors evaluation in full scale test chambers for reliable Indoor Air Quality monitoring Author(s): Valerie Goletto, Genevieve Mialon, Timothe Faivre, Isabelle Lesieur, Ying Wang
	15:30	539	A Study on the Influence of Meteorological Parameters to Daily Variation of Indoor Radon Concentrations Author(s): Ji Hyun Park, Hyun Young Lee, Cheol Min Lee, Dae Ryong Kang
	15:30	561	Temporal variation of indoor air quality of elementary school, kindergarten and day-care center in Korea Author(s): Boram Lee, Kiyoun Lee
	15:30	593	A calibration method for low-cost PM2.5 sensors and the deviation of their values caused by relative humidity Author(s): Xiangdong Li, Lei Zhao, Xilei Dai, Junjie Liu
	15:30	456	CEATIC-RP : Exposition knowledge in air of individual and collective transport's cockpits in Paris area Author(s): Bertrand Frere, Guénaél Thiault, Laurence Durupt, Romain Molle, Claire Kaiser, Sophie Besancon, Marie-Aude Kerautret, Hanitriinala Ravelomanantsoa

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session F: Concentrations and Exposure 4 (Chair: Horace Mui)
Tues 7/24	15:30	617	Experimental study on kitchen pollutant transmission in an apartment Author(s): Zhengwei Long, Hao Zhang, Xionglei Cheng, Wuxuan Pan, Sumei Liu, Qingyan Chen
	15:30	624	Winter field measurements on residential indoor volatile organic compounds (VOCs) in Hangzhou, China: a preliminary study Author(s): Zhiyi Wei, Kai Gao, Jun Guan, Xu Zheng, Yabin Jia, Xiufeng Tian, Huafang Zhang, Shuqin Chen
	15:30	671	Low-cost air quality sensors: key to data abundance? Author(s): James McGrath, Liz Coleman, Sean O Griofa, Eoin Ó Léime, Colin O'Dowd, Miriam Byrne
	15:30	675	Indoor temporal variation of volatile organic compounds in 4 occupied university classrooms in China: a pilot study Author(s): Xu Zheng, Zhiyi Wei, Kai Gao, Jun Guan, Chenjun Lin, Xue Tan, Huafang Zhang, Shuqin Chen
	15:30	724	An investigation into indoor air quality in volume apartment buildings in Melbourne, Australia Author(s): Nick Familiari, Olubukola Tokede, Mark Luther, Steve Atkinson
	15:30	766	Field measurements on PM1, PM2.5 and PM10 exposure levels inside a long road tunnel in Dalian, China Author(s): Chenglong Jiang, Yu Zhao, Liangdong Ma, Jili Zhang
	15:30	792	Review on Indoor Environment Monitoring Methods Author(s): Fang Hou, Han Wang, Baizhan Li, Hong Liu, Wei Yu
	15:30	799	Seasonal Variation of Indoor Air Quality and Indoor Thermal Conditions of 220 Classrooms in the Midwest Region Author(s): Josephine Lau, Shihan Deng

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session G: Energy, Climate Change, and Policy 1 (Chair: Bill Bahnfleth)
Tues 7/24	15:30	27	Energy audit and indoor air quality in apartment building in Slovakia Author(s): Imrich Sánka, Dusan Petras
	15:30	127	Experiment for Effect of Introducing PCM in Test Chamber Assuming Houses Author(s): Jinya Takeuchi, Kenichi Hasegawa, Shinichi Matsumoto
	15:30	193	Performance of the ground source hybrid power driven heat pump Author(s): Sheng Shang, Xianting Li, Baolong Wang
	15:30	331	Energy and environmental impact assessment of straw return and substitut-ing straw molding fuel for heating coal in rural China: a case study Author(s): Shuangqi Zhang, Mengsi Deng, Ming Shan, Chuang Zhou, Wei Liu, Xiaoqiu Xu, Xudong Yang
	15:30	363	Operation Method for Self-Consumption of Surplus Power Considering Thermal Comfort in a Zero Energy House Author(s): Yugo Tsuneoka, Yuka Maruyama, Tianshu Xu, Maho Ichikawa, Junta Fujisawa, Shinichi Tanabe, Yasuhiro Hayashi
	15:30	460	Development and Thermal Performance Evaluation of Mixed Shape-stabilized PCMs for Application in buildings Author(s): Hwayoung Lee, Seunghwan Wi, Sumin Kim, Hyun Mi Cho, Beomyeol Yun
	15:30	220	The Applicability of Mechanical Ventilation with Heat recovery in Residential Buildings in China Author(s): Sihua Chen, Zhongping Lin, Deng Wang
	15:30	620	Usage Characteristics and Energy Consumption of Room Air Conditioner (RAC) in Chongqing Area Based on Big Data Monitoring Author(s): Kai Xue, Meng Liu, Ziwei Zhang, Lu Yan, Tingting Jiang

Day	Time	ID	Poster Session H: Health Effects and Epidemiology 1 (Chair: Claudia Miller)
Tues 7/24	15:30	129	Effect of streamer plasma irradiation on ambient PM2.5-induced pro-inflammatory responses in human bronchial epithelial cells Author(s): Toshio Tanaka
	15:30	158	Suggestions for healthy indoor air and thermal environments in residences of elderly people living independently Author(s): Asako Hasegawa
	15:30	269	Verification of the Influence of Thermal Environment on Factors Associated with Falls Author(s): Kohei Fujita, Shintaro Ando, Koshiro Shinohara, Toshiharu Ikaga
	15:30	170	Effects of Precipitation on Infectious Diseases Following Typhoons Author(s): How-Ran Guo, Yen-Cheng Tseng, Francesca Prophete
	15:30	870	Healthy Housing and Indoor Air Quality: A Chicago Field Study Author(s): Parham Azimi, Tim Crowder, Anne Evens, Margaret Garascia, Amanda Gramigna, Anna McCreery, Rachel Scheu, Brent Stephens
	15:30	825	Evolution of Indoor Air Research and Application Author(s): Hal Levin
	15:30	451	New Certification System for Workplace Wellness and Comfort in Japan Author(s): Shinichi Tanabe
	15:30	172	Development of a Respirable Virtual-Cyclone Sampler Author(s): Ting-Ju Chen, Yu-Mei Kuo, Ching-An L?, Chih-Wei Lin, Sheng-Hsiu Huang, Chih-Chieh Chen

## Detailed Technical Program

Tuesday, July 24<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session I: Sources and Emissions 3 (Chair: Yilin Tian)
Tues 7/24	15:30	325	A novel method for volatile organic compounds source identification in transportation vehicle cabins: reduced scale chamber experiment Author(s): Wenjie Huang, Mengqiang Lv, Xudong Yang
	15:30	530	An Experimental Study about the Effect of Temperature on Formaldehyde and Volatile Organic Compounds (VOCs) Emissions from Wood Lacquer Author(s): Li Huang, Weihui Liang, Menghao Qin
	15:30	622	Air Quality assessment during indoor use of the Tobacco Heating System Author(s): Catherine Goujon Ginglinger, Maya Mitova, Michel Rotach, Pascal Pratte
	15:30	627	Comparison of Formaldehyde Concentrations in Emission Test Chambers Using EN 717-1 and EN 16516 Author(s): Olaf Wilke, Oliver Jann
	15:30	841	A novel approach to determine the SVOC uptake of textiles Author(s): Birte Mull, Glenn Morrison, Erik Uhde, Deniz Varol, Tunga Salthammer
	15:30	648	A Discussion on Model Scenarios in VOC Emission Testing Standards for Residential Building Materials Author(s): Wenhao Chen, Alfred Hodgson, Scott Steady, Kazukiyo Kumagai
	15:30	866	Emission of VOCs and SVOCs from polymeric materials used in commercial products Author(s): Akihiro Yamasaki, Miyuki Noguchi

Day	Time	ID	Poster Session J: Ventilation and HVAC Systems 3 (Chair: Marco-Felipe King)
Tues 7/24	15:30	609	The future of passive techniques in air change rate measurement Author(s): Sarah Lima Paralovo, Marianne Stranger, Maarten Spruyt, Joris Lauwers, Jelle Laverge
	15:30	613	Local Determination of the Building Envelope Air Leakage Author(s): Mikael Björling, Anders Kumlin, Peter Carlsson
	15:30	634	Variability in Dwelling Air Exchange Rates due to Meteorological Conditions Author(s): Miriam Byrne, James McGrath
	15:30	105	Modular and Adjustable Ventilation Using Induced Jet Fans for a Multi-Purpose Large Space Author(s): Wei Ye, Qianru Zhang, Shengji Wang, Xu Zhang
	15:30	693	The effect of the thermal obstructions on the velocity and temperature field in an operating room with laminar airflow Author(s): Anders Nilssen, Amar Aganovic, Guangyu Cao, Liv-Inger Stenstad, Jan Gunnar Skogås
	15:30	719	Methodology to assess the exposure to cooking emissions in combination with the efficiency of range hoods Author(s): Wouter Borsboom, Piet Jacobs, Willem De Gids, Iain Walker
	15:30	809	Effects of Ventilation Methods on Indoor Air Quality of HVAC-Equipped Public Elementary Schools Author(s): Kenta Sakai, Daisuke Nakamura, Haruno Ishikawa, Shin-ichi Tanabe, Moe Matsuda, Tetsuya Sato



## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Air Cleaning and Filtration 4: Sorbents Chairs: William Fisk, Mark Jackson Room 201B
Wed 7/25	10:30	307	Evaluating the performance of CO <sub>2</sub> sorbent materials for indoor air cleaning applications Author(s): Xiaochen Tang, Sébastien Houzé De L'Aulnoit, Jonathan Slack, Mark Buelow, Brett Singer, Hugo Destailats
	10:45	322	Functionalized mesoporous materials to capture carbonyl compounds such as aldehydes Author(s): Vincent Chevalier, François Tardif, Jérôme Martin
	11:00	453	Toluene Adsorption Performance of Mortar Adhesives Using Carbon nanomaterial for Improving Indoor Air Quality Author(s): Seunghwan Wi, Hwayoung Lee, Seong Jin Chang, Su-Gwang Jeong, Jongki Lee, Sumin Kim
	11:15	474	On the Dependence of the Partition Coefficient on the Challenge Concentration of VOCs on Activated Carbon: An Experimental Study Author(s): Chuan He, Beverly Guo, Jensen Zhang
	11:30	610	Prediction of the Time-Dependent Efficiency of Adsorbent-Based Air Cleaners for Gas Pollutants Author(s): Philippe Berne, Christophe Brouard, Vincent Chevalier, Luana Golanski, Arthur Roussey, Barnabé Wayser, Olivier Dellea
	11:45	502	Evaluating air purification technologies for the aircraft cabin environment Author(s): Randy Maddalena, Hugo Destailats, Marion Russell, Xiaochen Tang, Toshifumi Hotchi, Stephen Trent, David Space, Dale Scheer

Day	Time	ID	Chemistry and Transformations 1: Ozone Chairs: Allen Goldstein, Cora Young Room 202A
Wed 7/25	10:30	139	Indoor Ozone Estimation from Outdoor Ozone and LBNL RC data 2001-02 Author(s): Mawuena Quarcoo, Derek Shendell
	10:45	361	Determining The Reaction Rate Of Ozone In Residential Garages Author(s): Jonathan Gingrich, Richard Corsi
	11:00	426	Ozone chemistry of building enclosure insulation materials Author(s): Kyle Chin, David Pleshakov, Brent Stephens, Elliott Gall
	11:15	701	Ozone deposition in portable classrooms in central Texas Author(s): Hagen Fritz, Richard Corsi, Atila Novoselac, Neil Crain
	11:30	427	Impact of indoor surface mass accretion on heterogeneous ozone chemistry Author(s): Elliott Gall, Donghyun Rim, Elena Christopher-Allison
	11:45	454	Effect of surface aging and soiling under real conditions on indoor surface reactivity with ozone Author(s): Malak Rizk, Michael Ward, Maxence Mendez, Ray Wells, Coralie Schoemaeker

## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Comfort, Productivity, and Perception 5: Thermal Models and Assessments Chairs: Shichao Liu, Hyojin Kim Room 201C
Wed 7/25	10:30	185	Urban Thermal Environment Measurement and Evaluation Using Small-scale Measuring Equipment Author(s): Akihisa Nomoto, Shinichi Tanabe, Masayuki Ogata, Junichi Asaka, Jun Nakagawa
	10:45	126	An Outdoor Thermal Comfort Model for Predicting the Probability Distribution of Thermal Sensation Author(s): Dayi Lai, Chuanming Chen, Wei Liu, Yifu Shi, Chun Chen
	11:00	202	Development of New Human Thermal Model based on Blood Flow Rate Measurements under Different Temperature Conditions Author(s): Tomonobu Goto, Daiki Terayama, Hiroto Sakamoto, Toshiyuki Hayase, Yoshifumi Saijo, Ryota Sugawara, Zhuoxi Niu
	11:15	251	Evaluation of the Thermal Environment of Waiting Room at Small-scale Railway Stations in Cold Regions Author(s): Shingo Yamaguchi, Junta Nakano, Kazuki Furumoto, Daisuke Nakamura, Yoshiki Ikeda, Keiichi Tsubouchi, Shinichi Tanabe
	11:30	232	Evaluation of Clothing Thermal Insulation based on Human Thermoregulation Model by Measuring Skin and Clothing Temperature Author(s): Kyungsoo Lee, Taehung Kim, Hyungkeun Kim, Hyeran Byun, Taeyeon Kim
	11:45	245	Experimental Investigations of Thermal Comfort in a Passenger Car under Driving Conditions Author(s): Xiaojie Zhou, Dayi Lai, Qingyan Chen

Day	Time	ID	Concentrations and Exposure 5: Indoor Particle Sources Chairs: Dusan Licina, Alireza Afshari Room 204A
Wed 7/25	10:30	260	Exposure to particles in secondhand vapor from e-cigarettes Author(s): Lance Wallace, Wayne Ott, Kai-Chung Cheng
	10:45	259	Ultrafine particle emissions and decay rates due to burning candles in a residence Author(s): Lance Wallace, Donghyun Rim
	11:00	303	Rapid Assessment of Indoor and Outdoor PM <sub>2.5</sub> Air Pollution Levels and Determinants in Rural Jalapa, Guatemala Author(s): Jiawen Liao, Oscar De Leon, Lisa Thompson, Erick Molliendo, Richardo Piedrahita, Eduardo Canuz, Anaité Diaz, John McCracken, Thomas Clasen, Michael Johnson
	11:15	795	Dynamics of Fine and Ultrafine Particulate Matter in Biomass Burning Kitchens in Western Kenya Author(s): Danielle Wagner, Samuel Odhiambo, David Lagat, Brandon Boor
	11:30	796	Emission Factors of Fine Particulate Matter, Organic and Elemental Carbon, Carbon Monoxide and Carbon Dioxide from Briquettes Made from Human Waste Author(s): Lupita Montoya, Wyatt Champion
	11:45	848	Pollutant emissions from a newly designed domestic space heating stove: comparison of various biomass pellets Author(s): Ming Shan, Mengsi Deng, Shuangqi Zhang, Xudong Yang

## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Sources and Emissions 3: Emissions Testing Methods Chairs: Hal Levin, Aneta Wierzbicka Room 204C
Wed 7/25	10:30	207	Signature-based novel method for IAQ evaluations toward effective and complete scale-up of small-scale IAQ measurements for full-scale spaces Author(s): Kwanghoon Han, Jensen Zhang
	10:45	342	Autonomous diffusive source for the validation of chamber testing Author(s): Erik Uhde, Niklas Aksteiner
	11:00	612	Comparison of volatile organic compounds in air sampled from climate chamber and Nalophane bags and the effect on odour acceptability Author(s): Helene Klinke
	11:15	320	Volatile organic compounds dynamic emission characteristics influenced by relative humidity in medium density fibreboard Author(s): Mengqiang Lv, Xudong Yang
	11:30	328	Two new promising approaches for quality assurance measures for materials emissions testing Author(s): Matthias Richter, Wolfgang Horn, Nils Mölders, Tilman Sauerwald, Caroline Schultealbert, Birte Mull
	11:45	364	An experimental method for measuring VOCs emitted from human skin Author(s): Ziwei Zou, Junzhou He, Xiao Sun, Xudong Yang

Day	Time	ID	Ventilation and HVAC Systems 3: Natural Ventilation and Infiltration Chairs: Jordan Clark, Christopher Y. H. Chao Room 204B
Wed 7/25	10:30	114	Window opening occurrence in the US: Influence of climate and region Author(s): Glenn Morrison, Gauri Date
	10:45	805	Predicting Window Opening Behavior of Individual Occupant Using Machine Learning Models Author(s): Bongchan Jeong, Heewon Choi, Junseok Park
	11:00	580	Determination of Window Operation Schedules in Chinese Residential Buildings Author(s): Yue Qi, Susu Jia, Dayi Lai, Junjie Liu
	11:15	616	Validation of cross ventilation models in a multi-zone residential apartment Author(s): Wuxuan Pan, Sumei Liu, Zhengwei Long
	11:30	758	Ventilation and Communication between Hidden and Occupied Spaces in Portable Classrooms: Air Flow and Labelled Particle Movement Author(s): Juan Maestre, Steve Bourne, Jianlin Ren, Molly Trump, Laurie Clotilde, Anthony Zografos, Atila Novoselac, Kerry Kinney
	11:45	873	What does “Use with adequate ventilation” mean? Author(s): Francis Offermann, Mark Nicas

## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Symposium 14: Improving practical microbial assessments for studying occupant health and investigating building health (Sponsored by the Sloan Foundation) Chairs: Rachel Adams, Mark Mendell Room 201A
Wed 7/25	10:30	486	What Evidence Linking Indoor Dampness and Mold to Health Is Still Needed to Better Protect Building Occupants? Author(s): Mark Mendell
	10:45	358	How can we make sequence-based approaches in microbiology relevant for studying buildings and the health of their occupants? Author(s): Rachel Adams
	11:00	688	Early Life Exposure to Fungal Communities and Allergic Disease Risk in Children Author(s): Joanne Sordillo
	11:15	690	Metagenomic characterization of fungal communities in inhalable broiler chicken production bioaerosols Author(s): Matthew Nonnenmann, Michael Chimenti, Morgan Farnell, Tom Tabler, Joey Bray, Kate O'Brien
	11:30	521	Characterization of indoor dust bacterial microbiota in homes of asthma and non asthma patients: a pilot study using next generation sequencing Author(s): Pierre Le Cann, Yanis Guenoune, Pierre Lemire, Jean Pierre Gangneux
	11:45		Discussion and summary

Day	Time	ID	Symposium 15: Numerical modeling of cross-ventilation flows: overview of past studies and discussion on future directions Chairs: Twan Van Hooff, Marco-Felipe King Room 202B
Wed 7/25	10:30	461	Modeling cross-ventilation with multi-zone models Author(s): Jelle Laverge
	10:45	276	Analysis and discussion of the performance of RANS and LES for cross-ventilation flow in a generic enclosure Author(s): Twan Van Hooff, Bert Blocken, Yoshihide Tominaga
	11:00	464	CFD of cross-flow ventilation of a full-scale cubical building using a time-dependent k-ε SST SAS turbulence model Author(s): Marco-Felipe King, Hannah Gough, Christos Halios, Janet Barlow, Catherine Noakes
	11:15	159	Coupled indoor/outdoor airflow simulation comparing ANSYS Fluent with a GPU-based lattice Boltzmann model for urban environments Author(s): Marco-Felipe King, Amirul Khan, Catherine Noakes
	11:30		Discussion and summary
	11:45		

## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Symposium 16: TILT: Identifying Initiators and Triggers of Chemical Intolerance Chairs: Claudia Miller, Ray Palmer Room 203A
Wed 7/25	10:30	769	Indoor Air, Chemical Intolerance, and Toxicant-Induced Loss of Tolerance (TILT) Author(s): Claudia Miller, Ray Palmer, Roger Perales, Rudy Rincon
	10:45	762	Validated Clinical and Epidemiological Approaches for Assessing Chemical Intolerance: The QEESI and BREESI Author(s): Ray Palmer, Roger Perales, Rudy Rincon, Claudia Miller, Carl Grimes
	11:00	765	What Initiates Chemical Intolerance? Author(s): Shahir Masri, Claudia Miller, Ray Palmer
	11:15	767	Environmental House Calls (EHC): Procedures and Methods in a Study to Identify Triggers for Chemical Intolerance Author(s): Roger Perales, Rudy Rincon, Ray Palmer, Claudia Miller
	11:30	771	Environmental House Calls (EHCs): Findings from the Toxicant-Induced Loss of Tolerance (TILT) Research Project Author(s): Rudy Rincon, Ray Palmer, Roger Perales, Claudia Miller
	11:45	761	Using the QEESI Symptom Star to Document Chemical Intolerance: A Case Study Author(s): Carl Grimes, Ray Palmer

## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	<b>Air Cleaning and Filtration 5: Systems and Performance</b> Chairs: Paolo Tronville, Shelly Miller Room 201B
Wed 7/25	13:30	141	Roles of Mechanical HVAC Systems, Particle Filters, and % Outdoor Air Intake Settings on Particle (0.3-0.5, 0.5-0.7 microns) Number Counts Author(s): Mawuena Quarcoo, Derek Shendell
	13:45	177	Comparison of Two Indoor PM2.5 Purification Strategies for Non-centralized Air-conditioned Buildings Author(s): Yuchen Shi, Xiaofeng Li
	14:00	209	Air Cleaning Performance of Desiccant Wheel Regenerated by Polluted Air in a Clean Air Heat Pump Author(s): Lei Fang, Ying Sheng, Jinzhe Nie
	14:15	785	Influence of uncertainty of test method on air purifier performance evaluation Author(s): Yihui Yin, Lei Zhao, Jingjing Pei, Junjie Liu
	14:30	545	Assessment of filtration performance of Fan Filter Unit (FFU) under natural and simulated haze: A classroom study Author(s): Kwok Wai Tham, Ganesh Parshetti, David Cheong, Chandra Sekhar
	14:45	482	Prototype of an Internet of Things (IoT)-based Human-Building Interaction for Energy Aware Better Indoor Air Quality Author(s): Seyed Hossein Sagheby, Patrick John

Day	Time	ID	<b>Chemistry and Transformations 2: Novel Advances</b> Chairs: Peter DeCarlo, Stephen Jackson Room 202A
Wed 7/25	13:30	236	A detailed modelling study of the impact of lighting on indoor air chemistry Author(s): Zixu Wang, Nicola Carslaw
	13:45	308	Aging of thirdhand tobacco smoke aerosols in the absence and presence of ozone Author(s): Xiaochen Tang, Noelia Ramirez, Marion Russell, Xavier Correig Blanchar, Lara Gundel, Hugo Destailats
	14:00	797	Investigation of Molecular Composition and Phase Partitioning of Organic Particles and Gases in a Residential Environment with Natural Ventilation Author(s): Claire Fortenberry, Michael Walker, Audrey Dang, Arun Loka, Gauri Date, Karolina Cysneiros De Carvalho, Glenn Morrison, Brent Williams
	14:15	618	Development of ISAM, a new indoor sectional aerosol model – linking gas-phase chemistry to aerosol through INCA-Indoor Author(s): Maxence Mendez, Patrice Blondeau, Nadège Blond, Didier Hauglustaine, Coralie Schoemaeker
	14:30	728	Chemical composition of airborne particles inside and outside a Swedish residence assessed by real time aerosol mass spectrometry Author(s): Yuliya Omelekhina, Axel Eriksson, Patrik Nilsson, Joakim Pagels, Aneta Wierzbicka
	14:45	878	Crystal Clear? Spectro-Microscopic Analysis of Indoor Glass Surfaces Author(s): Victor Or, Sarah Schwab, Michael Wade, Richard Corsi, Vicki Grassian

## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	<b>Comfort, Productivity, and Perception 6: Awareness and Control</b> Chairs: Joon-Ho Choi, Marzenna Dudzinska Room 201C
Wed 7/25	13:30	282	A comprehensive approach to evaluating the urgency of IAQ measures Author(s): Katja Tähtinen, Sanna Lappalainen, Kirsi Karvala, Heidi Salonen
	13:45	471	Experimental Evaluation of the Micro-Environmental Control System in Maintaining Thermal Comfort Author(s): Meng Kong, Jensen Zhang, Thong Dang, Ezzat Khalifa
	14:00	788	Preliminary Results: Different Indoor Classroom Conditions during Different Seasons in the U.S. Midwestern Region and their Associations with Student Absenteeism Author(s): Josephine Lau, Shihan Deng
	14:15	712	The Effect of a Low-Energy Wearable Thermal Device on Human Comfort Author(s): Zhe Wang, Maohui Luo, Hui Zhang, Yingdong He, Ling Jin, Edward Arens, Shichao Liu
	14:30	495	Development of an Integrated Task/Ambient Air Conditioning Outlet - Evaluation of a Single-Fan Outlet through Actual Office Measurements Author(s): Takashi Akimoto, Yoichi Nakashima, Takashi Yanai, Takashi Matsumoto, Daiki Yamashina, Naoya Odagiri
	14:45	736	Heating and cooling the human body with energy-efficient personal comfort systems (PCS) Author(s): Maohui Luo, Hui Zhang, Edward Arens, Ali Ghahramani, Zhe Wang, Ling Jin, Yingdong He

Day	Time	ID	<b>Concentrations and Exposure 6: Facilitating Large-scale Exposure Assessments</b> Chairs: Philip Hopke, Lance Wallace Room 204A
Wed 7/25	13:30	329	European Harmonization of Health Criteria for Construction Products: Progress and Current Challenges Author(s): Ana Maria Scutaru
	13:45	343	A volatile organic compounds (VOCs) emission database of building materials for indoor pollutant loads and concentration estimations Author(s): Weihui Liang, Mengqiang Lv, Li Huang
	14:00	191	Indoor Airborne Benzo[a]pyrene (BaP) in Different Countries and Its Influencing Factors Author(s): Zhaoyu Wang, Shanshan Shi, Menghao Qin
	14:15	683	Indoor air quality in French office buildings: a nationwide study Author(s): Corinne Mandin, Laetitia Malingre, Anthony Gregoire, Claire Dassonville, Olivier Ramalho
	14:30	614	Predicting Indoor Exposure to Outdoor Air Pollution in Residential Buildings on a U.S County Level Using GIS Author(s): Prateek Pant, Michael Waring
	14:45	500	Screen-Level Estimation of Crawling-Induced Exposure to Particle-Phase Phthalates Author(s): Chenyang Bi, Ying Xu

## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Energy, Climate Change, and Policy 1: Household Energy Chairs: Paul Francisco, Elliott Gall Room 202B
Wed 7/25	13:30	321	Characterizing the impact of biomass pellet re-loading mode on cookstove thermal and emission performances Author(s): Mengsi Deng, Shuangqi Zhang, Jiarong Li, Xing Rong, Ming Shan, Xudong Yang
	13:45	501	Assessment of Household Air Pollution from Burning Firewood and Yak Dung on the Eastern Tibetan Plateau Author(s): Wenlu Ye, Eri Saikawa, Alexander Avramov, Seung-Hyun Cho, Ryan Chartier
	14:00	787	A Culturally-Appropriate Household Heating Energy Transition for the Navajo Nation Author(s): Lupita Montoya, Wyatt Champion
	14:15	810	Analysis of rural household energy consumption based on on-site survey in Chongqing, China Author(s): Yujing Cao, Meng Liu
	14:30	741	Preliminary Indoor Air Quality Impacts of Clean Space Heating Programs for Rural Homes in Northern China Author(s): Ellison Carter, Jill Baumgartner, Brian Robinson, Chris Barrington-Leigh
	14:45	316	Associations between energy retrofits and indoor air quality parameters in Finnish and Lithuanian multi-family buildings Author(s): Liuliu Du, Virpi Leivo, Tadas Prasauskas, Mari Turunen, Dainius Martuzevicius, Ulla Haverinen-Shaughnessy

Day	Time	ID	Ventilation and HVAC Systems 4: Thermal Comfort and Performance Chairs: Atila Novoselac, Jordan Clark Room 204B
Wed 7/25	13:30	837	Reducing building over-cooling by adjusting HVAC supply airflow setpoints and providing personal comfort systems Author(s): Hui Zhang
	13:45	336	Thermal Performance Evaluation of a Small Duct High Velocity System Using NIST's Net-Zero Energy Residential Test Facility Author(s): Khiem Nguyen, Hyojin Kim, Lisa Ng, Vance Payne
	14:00	311	Verification of thermal comfort and PV generation self-consumption operation effect under precooling operation Author(s): Jungmin Kim, Tianshu Xu, Yuka Maruyama, Yugo Tsuneoka, Shingo Yamaguchi, Shinichi Tanabe, Yasuhiro Hayashi, Naomi Morito
	14:15	607	Operation of a novel two-pipe active beam system in an office building: a thermal comfort study Author(s): Alessandro Maccarini, Göran Hultmark, Niels Bergsøe, Alireza Afshari
	14:30	709	The Impact of different low-exergy heating systems and HVAC control settings on thermal comfort and energy performance Author(s): Ema Nemethova, Dusan Petras
	14:45	484	Performance characteristics of HVAC&R systems: a comparison of Ground Source Heat Pump and Combined Heat and Power systems Author(s): Xiaolei Yuan, Mehdi Shahrestani, Dan Fernbank, Jinxiang Liu, Xinjie Xu



## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

### Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Sources and Emissions 4: SVOCs Chairs: Jason Ham, Tunga Salthammer Room 204C
Wed 7/25	13:30	659	Home is where the SVOCs are: Semivolatile organic compounds in indoor air studied by thermal desorption aerosol gas chromatography (SV-TAG) Author(s): Kasper Kristensen, David Lunderberg, Yingjun Liu, Pawel Misztal, Yilin Tian, Caleb Arata, Rebecca Wernis, William Nazaroff, Allen Goldstein
	13:45	388	A Novel Rapid Method for Characterizing Emissions of Semivolatile Organic Compounds from Building Materials and Consumer Products Author(s): Hongwan Li, Chenyang Bi, Ying Xu
	14:00	450	Study on SVOC emissions from vehicle cabin materials: parameter determination, impact factors and preliminary exposure analysis Author(s): Tao Yang, Zhangcan He, Jianyin Xiong
	14:15	571	Equilibrium relationship between SVOCs in PVC products and the air in contact with the product Author(s): Clara Eichler, Yaoxing Wu, Jianping Cao, John Little
	14:30	574	The Effect of Grime Layers on Indoor Surfaces on SVOC Emission and Transport Author(s): Clara Eichler, Jianping Cao, John Little
	14:45	755	SVOCs Levels in House Dust from Urban Dwellings with Schoolchildren in Six Chinese Cities Author(s): Guangtao Fan, Jingchao Xie, Hiroshi Yoshino, Naoki Kagi, Kenichi Hasegawa, U Yanagi, Jiaping Liu

Day	Time	ID	Symposium 17: Water on surfaces and dust: Implications for indoor chemistry and microbiology (Sponsored by the Sloan Foundation) Chairs: Jeffrey Siegel, Karen Dannemiller Room 201A
Wed 7/25	13:30	196	Dynamics of residential oxidized organic gases: Insights into sources and sinks Author(s): Sara Duncan, Sophie Tomaz, Marc Webb, Jason Surratt, Glenn Morrison, Joanna Atkin, Barbara Turpin
	13:45	696	Primary and secondary plasticizer emissions in relation to material and ambient conditions - case descriptions from new buildings Author(s): Miia Pitkäranta, Jarno Komulainen, Helena Järnström
	14:00	698	Building and Environmental Factors that Influence Bacterial and Fungal Loading on Air Conditioning Cooling Coils Author(s): Alexa Bakker, Jeffrey Siegel, Mark Mendell, Jordan Peccia
	14:15	656	When Does Wet Drywall Not Grow Mold? Author(s): Claire Lepine, Jeffrey Siegel, James Scott, J. Gregory Caporaso, Phil Fan
	14:30	131	Modeling Microbial Growth in Carpet Dust at Varying Relative Humidity Levels using the "Time-of-Wetness" Model Author(s): Sarah Haines, Karen Dannemiller
	14:45	710	Gene Expression of Fungal Communities in Damp Buildings: Implications for Human Health Author(s): Bridget Hegarty, Karen Dannemiller, Jordan Peccia

## Detailed Technical Program

Wednesday, July 25<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Symposium 18: Indoor Air Quality in Energy Efficient New Homes: Findings from Field Studies in North America, China and Europe Chairs: Brett Singer, Mickael Derbez, Sarka Langer, Junjie Liu, Morgan MacNeil, Peter Tappler, Wanyu Chan Room 203A
Wed 7/25	13:30	271	Indoor air quality in 72 energy-efficient dwellings in France Author(s): Mickael Derbez, Eline Le Ponner, Olivier Ramalho, Jacques Riberon, Corinne Mandin
	13:45	542	Indoor Air Quality in New California Homes with Mechanical Ventilation Author(s): Wanyu Chan, Yang-Seon Kim, Brett Singer, Iain Walker
	14:00	178	Indoor Air Quality in energy-efficient buildings in Sweden: comparison with the Swedish residential housing stock and new conventional buildings Author(s): Sarka Langer, Despoina Teli, Lars Ekberg
	14:15	585	Indoor air quality in different age homes Author(s): Junjie Liu, Xilei Dai, Yihui Yin, Jingjing Pei
	14:30	148	Volatile Organic Compounds (VOCs) in New Homes Author(s): Morgan MacNeill, Doyun Won, Nina Dobbin, Melissa St-Jean, Patrick Goegan
	14:45		Discussion and Summary

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Chemistry and Transformations 3: Methods and Detection Chairs: Marina Vance, Joel Harrison Room 201A
Thurs 7/26	10:30	222	Development of a Peracid Vapor Sampling Method Author(s): Stephen Jackson, Jason Ham, Joel Harrison, Ray Wells
	10:45	326	Reaction products formed on solid sorbents during analyses of very volatile organic compounds (VVOCs) Author(s): Alexandra Schieweck, Tunga Salthammer
	11:00	332	Gas-phase detection of amines and their influence on terpene ozonolysis Author(s): Joel Harrison, Stephen Jackson, Jason Ham, Ray Wells
	11:15	663	Development of a Field-Portable Cavity-Ringdown Spectrometer for In-door Measurements of the Nitrate Radical (NO <sub>3</sub> •) Author(s): Jason Ham, Larry Lee, Joel Harrison, Stephen Jackson, Ray Wells
	11:30	747	Impacts of Natural Ventilation on Gas and Particle Phase Organic Compounds Indoors: Insights from Chromatogram Binning - Positive Matrix Factorization Analysis Author(s): Michael Walker, Claire Fortenberry, Arun Loka, Audrey Dang, Gauri Date, Karolina Cysneiros De Carvalho, Glenn Morrison, Brent Williams
	11:45	768	Development and use of a portable surface flow reactor to investigate uptake of VOCs to indoor surfaces Author(s): Lucas Algrim, Anne Handschy, Derek Price, Demetrios Pagonis, Shelly Miller, Douglas Day, Joost De Gouw, Jose Jimenez, Paul Ziemann

Day	Time	ID	Concentrations and Exposure 7: Transmission and Dispersion Chairs: Donghyun Rim, Chun Chen Room 204A
Thurs 7/26	10:30	266	Effect of Surface Roughness on Droplet Resuspension Behavior Author(s): Cunteng Wang, W. T. Leung, Sc Fu, Yuguo Li, Christopher Chao
	10:45	283	Face-Touching Frequency for Evaluation of Infection Risk Author(s): Kaho Hashimoto, Maho Ichikawa, Yuichi Akiyama, Masayuki Ogata, Shinichi Tanabe, Satoshi Hori, Hitomi Tsutsumi
	11:00	152	Human Touch Behaviours in a Research Student Office for Application into Fomite Transmission of Diseases Author(s): Nan Zhang, Yuguo Li, Shenglan Xiao
	11:15	402	Experimental Modelling of Infectious Aerosols from People with Cystic Fibrosis Author(s): Jessica Proctor, Catherine Noakes, Nikil Kapur, Louise Fletcher, Ian Clifton
	11:30	677	Experimental Measurements of Thermal Plumes Profiles over a Simulated Patient on an Operating Table Author(s): Guangyu Cao, Madeleine Storås, Anders Nilssen, Amar Aganovic, Liv-Inger Stenstad, Jan Gunnar Skogås
	11:45	570	Validated numerical simulations of wall-mounted kitchen range hood pollutant capture and sensitivity tests to inform development of a method of test Author(s): Sasan Sadrizadeh, Gabriel Rojas, Jordan Clark, Iain Walker, Max Sherman

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Health Effects and Epidemiology 1: Allergy and Asthma Chairs: Mark Mendell, Kazukiyo Kumagai Room 201C
Thurs 7/26	10:30	669	Association between Air Change Rate and Children's Allergic Symptoms in Naturally Ventilated Dwellings in Tianjin, China Author(s): Jing Hou, Yufeng Zhang, Yuexia Sun, Pan Wang, Qingnan Zhang, Xiangrui Kong, Sundell Jan
	10:45	511	Home Air Conditioning Mitigates Effect of Ambient Temperature on Asthma and Allergic Rhinitis among Preschool Children Author(s): Chan Lu, Qihong Deng, Wei Jiang
	11:00	412	Associations between House Dust Phthalates and Children's Allergic Rhinitis in Baotou, China Author(s): Lifang Wang, Bi Luyao, Chuai Yufeng, Yinping Zhang, Jan Sundell
	11:15	615	Early Findings from Tribal Indoor Air Quality Study Author(s): Ulla Haverinen-Shaughnessy, Richard Shaughnessy

Day	Time	ID	Microbiology and Dampness 3: Transmission and Transport Chairs: Lars Gunnarsen, Kerry Kinney Room 201B
Thurs 7/26	10:30	147	Predicting the transmission process of viruses on multiple surfaces with a Markov chain model Author(s): Shenglan Xiao, Yuguo Li, Nan Zhang
	10:45	588	Viral respiratory pathogens on frequently touched surfaces at transportation hubs Author(s): Anniina Salmela, Niina Ikonen, Carita Savolainen-Kopra, Joanne Enstone, Satu Salo, Ilpo Kulmala, Anna-Maria Veijalainen, Jonathan Nguyen-Van-Tam, Petri Ruutu, Pertti Pasanen
	11:00	583	Microbial concentration on the handlebar of sharing bicycles differs from those of private bicycles Author(s): Jin Ye, Hua Qian, Xiaohong Zheng
	11:15	333	Impacts of Synthetic and Natural Indoor Surface Finishes on Microbial Viability Author(s): Jinglin Hu, Erica Hartmann
	11:30	197	Experimental investigation of detaching <i>Aspergillus niger</i> spores from colonies Author(s): Xian Li, Tengfei Zhang, Shugang Wang
	11:45	398	Shut the front door: seasonal patterns in window operation drive fungal and bacterial community dissimilarity between indoor and outdoor air Author(s): Roo Vandegrift, Sue Ishaq, Jeff Kline, Ashkaan Fahimipour, Jason Stenson, Ryann Crowley, Hannah Wilson, Dale Northcutt, Erica Hartmann, Deb Johnson-Shelton, G.Z. Brown, Jessica Green, Kevin Van Den Wymelenberg

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Sources and Emissions 5: Phthalates Chairs: Erik Uhde, Dustin Poppendieck Room 204C
Thurs 7/26	10:30	727	Experimental Investigation on Effect of Temperature and Humidity on Gas/Particle Partition Coefficient of Indoor Phthalate Esters Author(s): Xinke Wang
	10:45	387	Direct Transfer of Phthalates from Polyvinyl Chloride Flooring into House Dust: A Chamber Study Author(s): Chenyang Bi, Ying Xu
	11:00	621	Exposure to Phthalate Esters (PAEs) in Social Housing Apartments Author(s): Yuchao Wan, Miriam Diamond, Jeffrey Siegel
	11:15	483	Deriving Indoor Source Strength of Bis (2-ethylhexyl) Phthalate From the Measured Concentration Associated With Indoor Settled Dust Author(s): Shanshan Shi, Yuexia Sun
	11:30	676	Time-resolved measurements of phthalates in a residence by thermal desorption aerosol gas chromatography (SV-TAG) Author(s): David Lunderberg, Kasper Kristensen, Yingjun Liu, Pawel Misztal, Yilin Tian, Caleb Arata, William Nazaroff, Allen Goldstein
	11:45	440	The effect of ventilation and temperature on phthalate concentration in house dust Author(s): Ya Hong Sun, Jingjing Pei

Day	Time	ID	Ventilation and HVAC Systems 5: Transmission and Distribution Chairs: Chandra Sekhar, Xudong Yang Room 204B
Thurs 7/26	10:30	132	Dispersion of pollutants released at floor level under three types of heating systems combined with mixing ventilation: experimental study Author(s): Laura Stasiuliene, Andrius Jurelionis
	10:45	267	The Impact of Sinusoidal Airflow Produced by Personalized Ventilation on Distribution of Airborne Droplets Author(s): Jingcui Xu, Sc Fu, Chi Yan Tso, C. L. Wu, Yuguo Li, Christopher Chao
	11:00	553	Healthcare worker exposure to airborne infections in isolation rooms Author(s): Petri Kalliomäki, Julian Tang, Matti Waris, Hannu Koskela
	11:15	732	Carbon Dioxide Patterns in Student Dormitory Rooms Monitored for Influenza Transmissions Author(s): Mohammad Heidarinejad, Kofi Addo, Daniel Dalgo, Nicholas Mattise, Donald Milton, Jelena Srebric
	11:30	694	Benefit/Cost Analysis of Ventilation Strategies to Reduce Airborne Infectious Disease Transmission in Schools Author(s): Sangeetha Kumar, Leigh Lesnick, Atila Novoselac, Richard Corsi
	11:45	119	Effect of Ceiling Surface Temperature on Indoor Air Distribution in a Simulated Office Room with Underfloor Air Distribution and Chilled Ceiling Author(s): Xiaozhou Wu

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Symposium 19: Applying Quantitative Microbial Risk Assessment (QMRA) to Estimate Human Health Impacts in the Indoor Air Environment Chairs: Charles Haas, Linsey Marr Room 202A
Thurs 7/26	10:30	116	The Quantitative Microbial Risk Assessment Framework Applied to Indoor Inhalation Exposures Author(s): Charles Haas
	10:45	124	Sources of Microorganisms in Indoor Air Author(s): Linsey Marr, Aaron Prussin II
	11:00	401	Analytical methods for microorganisms in the indoor environment and challenges for exposure assessment Author(s): Ashleigh Bope, Samuel Cochran, David Kormos, Karen Dannemiller
	11:15	366	Predicting Influenza Exposures in Multi-zone Indoor Environments Using a Complex Infection Transmission Model Author(s): Parham Azimi, Brent Stephens
	11:30	801	Estimating exposure to infectious influenza aerosols in roommates of influenza cases during the 2012-2013 season on the University of Maryland campus Author(s): Jacob Bueno De Mesquita, Donald Milton, Mohammad Heidarinejad, Kofi Addo, Daniel Dalgo, Nicholas Mattise, Jelena Srebric
	11:45		Discussion and summary

Day	Time	ID	Symposium 20: Emissions from humans: What do we know and what should we know? Chairs: Pawel Wargocki, Sarka Langer, Gabriel Bekö Room 202B
Thurs 7/26	10:30	200	Human bioeffluents: Are exhaled and dermally-emitted bioeffluents different? Author(s): Sayana Tsushima, Pawel Wargocki, Shinichi Tanabe
	10:45	281	Emissions from Humans and Indoor Air Chemistry Author(s): Sarka Langer, Gabriel Bekö, Charles Weschler, Karine Arrhenius, Pawel Wargocki
	11:00	678	Field measurements of human VOC bioeffluents using PTRMS Author(s): Pawel Misztal, Xiaochen Tang, Yingjun Liu, Yilin Tian, Caleb Arata, Kasper Kristensen, David Lunderberg, Jianyin Xiong, William Nazaroff, Allen Goldstein
	11:15	350	Investigating human emissions of volatile organic compounds in a cinema, flux rates, links to scene content, and possible applications Author(s): Christof Stoenner, Achim Edtbauer, Bettina Derstroff, Efstratios Bourtsoukidis, Thomas Kluepfel, Jörg Wicker, Jonathan Williams
	11:30	288	The Effects of Bioeffluents on Health Symptoms, Perceived Air Quality and Cognitive Performance – Summary of Current Evidence Author(s): Xiaojing Zhang, Pawel Wargocki, Zhiwei Lian, Jingchao Xie, Jiaping Liu
	11:45		Discussion and summary

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Symposium 21: How (and why) does filter efficiency change over time? Chairs: Jeffrey Siegel, Brandon Boor Room 203A
<b>Thurs 7/26</b>	10:30	754	Efficiency Declines in Residential Electret Filters Author(s): Jeffrey Siegel
	10:45	700	The Influence of HVAC Usage on Filter Properties and Collected Dust Author(s): Kathleen Owen
	11:00	465	How Monitoring the Behavior of HVAC Systems Can Support Filter Performance Assessment Author(s): Paolo Tronville, Michel Noussan, Giovanni Carioni, Victor Rivas, Richard Rivers
	11:15	735	Estimates of fine and ultrafine particle removal efficiency for residential HVAC filters using in-situ size-resolved efficiency measurements Author(s): Torkan Fazli, Brent Stephens, Yicheng Zeng
	11:30	594	A washable electrostatically assisted coarse filter with high filtration efficiency for ambient particles and low pressure drop Author(s): Enze Tian, Jinhua Mo
	11:45		Discussion and summary

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Chemistry and Transformations 4: Indoor Sources Chairs: Maxence Mendez, Allen Goldstein Room 201A
Thurs 7/26	13:30	162	Skin and breath emissions as a source of indoor air pollution in a classroom Author(s): Magdalena Kruza, Ally Lewis, Nicola Carslaw
	13:45	598	Non-combustible air fresheners: exposure and health risk assessment Author(s): Guillaume Karr
	14:00	179	The major role of temperature on indoor concentrations of air toxic VOCs in 9 houses based on in-situ high time resolution measurements Author(s): Yibo Huangfu, Nathan Lima, Patrick O'Keeffe, Beiyu Lin, Diane Cook, Von Walden, William Kirk, Shelley Pressley, Brian Lamb, Bertram Jobson
	14:15	383	Impact of changing cleaning product formulation on indoor air chemistry Author(s): Nicola Carslaw, Magdalena Kruza
	14:30	725	Time-Resolved Measurements of Indoor Chemistry, Emission Rates, and Deposition Velocities in a University Art Museum Author(s): Demetrios Pagonis, Derek Price, Lucas Algrim, Douglas Day, Anne Handschy, Shelly Miller, Joost De Gouw, Jose Jimenez, Paul Ziemann
	14:45	243	Dynamic chamber method for measuring particle/air partition coefficient of indoor semi-volatile organic compounds (SVOCs) Author(s): Jianping Cao, Yaoxing Wu, Clara Eichler, John Little

Day	Time	ID	Concentrations and Exposure 8: Transportation, Public Spaces, and Other Environments Chairs: Louise Weschler, Parham Azimi Room 204A
Thurs 7/26	13:30	630	Measurement and Analysis of In-Cabin Ultrafine Particles in 4 Commercial Flights Author(s): Yabin Jia, Zhiyi Wei, Jun Guan
	13:45	359	How do atmospheric ultrafine particles penetrate into the cabin of a waiting commercial airliner and affect passengers' health? A case study at Tianjin Airport, China Author(s): Jianlin Ren, Junjie Liu, Xiaodong Cao, Fei Li
	14:00	672	VOC and SVOC exposures in vehicles Author(s): Yaoxing Wu, Xiaoyu Liu
	14:15	146	Air quality in a Norwegian indoor swimming pool facility: A Case study Author(s): Therese Nitter, Kristin Svendsen, Bjorn Aas
	14:30	348	The effect of temperature on emissions of carboxylic acids in passive climate controlled repositories with cultural heritage collections Author(s): Signe Hjerrild Smedemark, Morten Ryhl-Svendsen, Alexandra Schieweck
	14:45	481	Rethinking the Conventional Wisdom about Air Sampling for Fungi in Initial Investigations Author(s): Michael McGuinness



## Detailed Technical Program

Thursday, July 26<sup>th</sup>

### Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Health Effects and Epidemiology 2: Environmental Conditions and Sleep Environments Chairs: Vito Ilacqua, Morgan MacNeill Room 201C
Thurs 7/26	13:30	134	Influence of environmental humidity on oral dryness among nursing home residents in Japan Author(s): Yukie Nakajima, Toshiharu Ikaga, Shintaro Ando, Tanji Hoshi
	13:45	106	Effects of thermal conditions and carbon dioxide concentration on building-related symptoms: a longitudinal study in air-conditioned office buildings Author(s): Kenichi Azuma, Naoki Kagi, U Yanagi, Hoon Kim, Noriko Kaihara, Motoya Hayashi, Haruki Osawa
	14:00	268	Multi-level Analysis of the Effect of Indoor Air Temperature on Physical Ability in an Elderly Japanese Population Author(s): Sho Sakamoto, Koshiro Shinohara, Shintaro Ando
	14:15	194	The Acute Impact of Biophilic Indoor Environment on Stress and Cognitive Function Author(s): Jie Yin, Shihao Zhu, Piers Macnaughton, Joseph G. Allen, John Spengler
	14:30	374	Identification of human body physiological response to bed micro-environment Author(s): Shintaro Kurasawa, Arsen Melikov, Hiroaki Ishizawa, Mariya Bivolarova
	14:45	744	Low Indoor-Air Humidity in an Assisted Living Facility is Correlated with Increased Patient Illness and Cognitive Decline Author(s): Stephanie Taylor, Michael Tasi

Day	Time	ID	Microbiology and Dampness 4: Methods and Applications Chairs: Charles Haas, Lars Gunnarsen Room 201B
Thurs 7/26	13:30	394	Comparison of Real-time Ultraviolet-Induced Fluorescence and Filter Sampling Combined with qPCR Assay for the Measurement of Airborne Fungal Spores Author(s): Christine Uebel-Niemeier, Jurate Virkutyte, Kelechi Isiugo, Reshmi Indugula, Jennie Cox, Mark Hernandez, Tiina Reponen
	13:45	587	Quantitative Filter Forensics to Determine the Airborne Concentration of Endotoxins and Allergens in Residential HVAC Filters Author(s): Raheleh Givehchi, Juan Maestre, Kerry Kinney, Dennis Wylie, Sharon Horner, Jeffrey Siegel
	14:00	242	Improving precision in the study of indoor fungi: recent changes and additions in the UNITE database for molecular identification of fungi Author(s): Henrik Nilsson, Andy Taylor, Urmas Kõljalg, Kessy Abarenkov
	14:15	703	The Redevelopment of Microbial Communities after School Desk Cleaning Author(s): Sarah Kwan, Ulla Haverinen-Shaughnessy, Richard Shaughnessy, Jordan Peccia
	14:30	541	Comparison of the methods analysing microbial contamination on building materials Author(s): Maria Valkonen, Katja Saarnio, Heidi Hyytiäinen, Martin Täubel, Anne Hyvarinen
	14:45	832	Comparing Real-time Ultraviolet-Induced Fluorescence with Hexosaminidase Activity for Assessing Airborne Fungal Spore Loads in Occupied K-12 Classrooms Author(s): Marina Nieto-Caballero, Odessa Gomez, Richard Shaughnessy, Mark Hernandez

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Sources and Emissions 6: Flame Retardants Chairs: Aneta Wierzbicka, Erik Uhde Room 204C
Thurs 7/26	13:30	315	Particle size distribution of organophosphate flame retardant (OPFRs) in indoor dust Author(s): Lingli Zhou, Wilhelm Püttmann
	13:45	447	Migration Mechanism of Phosphorus Flame Retardants from Flame-Retardant-Treated Polyester Curtains to Indoor Dust Author(s): Masahiro Tokumura, Sayaka Ogo, Kazunari Kume, Kosuke Muramatsu, Qi Wang, Yuichi Miyake, Takashi Amagai, Masakazu Makino
	14:00	396	Phthalate, Organophosphates, Polybrominated Diphenyl Ethers, Pesticides, and Their Alternatives in Indoor Air and Dust in U.S. High School Author(s): Hongwan Li, Chenyang Bi, Neil Crain, Atila Novoselac, Kerry Kinney, Richard Corsi, Ying Xu
	14:15	507	Novel Phosphorus Flame Retardants Found from Flame-Retardant Curtains Purchased from Japanese Market Author(s): Yuichi Miyake, Masahiro Tokumura, Qi Wang, Takashi Amagai
	14:30	182	Sorption of organophosphate flame retardants on impervious surfaces Author(s): Xiaoyu Liu, Yirui Liang, Matthew Allen
	14:45	499	Semi-volatile Organic Compounds in Indoor Settled and HVAC filter dust: Association with Seasons, Childhood Asthma and Building characteristics Author(s): Chenyang Bi, Juan Maestre, Jeffrey Siegel, Kerry Kinney, Ying Xu

Day	Time	ID	Ventilation and HVAC Systems 6: Fluids and Flows Chairs: Mohammad Heidarinejad, Elisa Van Kenhove Room 204B
Thurs 7/26	13:30	455	Experimental study of human thermal plumes in a small space via large-scale TR PIV system Author(s): Jiayu Li, Junjie Liu, Jingjing Pei, Krishna Mohanaragam, William Yang, Bin Li, Yaqun Cao
	13:45	555	Experiment study of air flow pattern under ceiling fan with Color Sequence Particle Streak Velocimetry Author(s): Huan Wang, Hong Zhang, Xianting Li, Yingxin Zhu
	14:00	559	Wind tunnel tests of pressure coefficient distribution and inter-flat pollutant transmission in a rectangular multistory residential building Author(s): Di Mu, Naiping Gao, Tong Zhu
	14:15	365	Study on Air Conditioning System Promoting Coanda Effect by Applying Shape of PC Ceiling Slab Author(s): Kosuke Kondo, Hisashi Hasebe, Akihiro Kawamura, Nozomu Ota, Hitomi Yamazaki
	14:30	192	Influence of entrance configuration on the performance of solar chimney Author(s): Shiyi Hong, Wenqing Ge, Jiayi Zhu, Guoqing He
	14:45	237	Development of a New Ventilation System for Commercial Airplane Cabins Author(s): Ruoyu You, Yongzhi Zhang, Xingwang Zhao, Chao-Hsin Lin, Zhigang Wei, Junjie Liu, Qingyan Chen

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

### Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Symposium 22: The use of low-cost sensors for monitoring indoor air and exposure Chairs: Andrea Ferro, Philip Hopke Room 202A
Thurs 7/26	13:30	286	Characterizing indoor-outdoor PM relationships using low cost monitors during two heating seasons in Rochester, New York Author(s): Gursumeeran Satsangi, Mauro Masiol, Nadezda Zikova, David Chalupa, David Rich, Philip Hopke, Andrea Ferro
	13:45	421	A Versatile Platform for Low-Cost PM Measurements Author(s): Christian L'Orange, Bonne Ford, Eric Wendt, Jessica Tryner, John Mehaffy, Scott Kelleher, Casey Quinn, Dan Miller-Lionberg, John Volckens
	14:00	405	Opportunities and barriers to the use of continuous, distributed indoor environmental sensing in green building rating systems Author(s): Chris Pyke, Seema Bhangar
	14:15	386	Development of a smartphone-based app for determination of formaldehyde concentration indoors Author(s): Siyang Zhang, Nick Shapiro, Gretchen Gehrke, Jessica Castner, Zhenlei Liu, Beverly Guo, Jensen Zhang, Sarah Haines, David Kormos, Paige Frey, Rongjun Qin, Karen Dannemiller
	14:30	881	An evaluation of low-cost particulate matter and CO2 sensors and their applications Author(s): Akram Ali, Haoran Zhao, Brent Stephens
	14:45		Discussion and summary

Day	Time	Workshop 3: Compliance in ventilation standards using natural ventilation Chairs: James Lo, Brent Stephens Room 203A	
Thurs 7/26	13:30	827	Compliance in Ventilation Standards using Natural Ventilation: Difficulty in quantifying minimum ventilation rate for transient flow Author(s): James Lo
	13:45		Workshop
	14:00		
	14:15		
	14:30		
	14:45		

Day	Time	Workshop 4: Household energy transitions to address air pollution exposure, health, and climate burdens associated with solid fuel burning Chairs: Ellison Carter, Nicholas Lam, Zoe Chafe, Ricardo Carvalho, Ming Shan, John Ackerly, Forrest Lacey Room 202B	
Thurs 7/26	13:30		Workshop
	13:45		
	14:00		
	14:15		
	14:30		
	14:45		

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session A: Air Cleaning and Filtration 3 (Chair: Louise Weschler)
Thurs 7/26	15:30	641	A study on the performance evaluation of air cleaner in some educational facilities to reduce fine dust Author(s): Hye-Won Lee, Na-Na Jeong, Ji-Hoon Seo, Jong-Ryeul Sohn
	15:30	666	How eco-friendly are air purification technologies? Author(s): Inga Stasiulaitiene, Edvinas Krugly, Povilas Andrijauskas, Dainius Martuzevicius
	15:30	743	Equivalent Air Change Rate by Upper Room UVGI system Author(s): Jongil Bang, Minki Sung, Sunsook Kim, Shinsuke Kato
	15:30	790	Monte Carlo molecular simulation of adsorption of formaldehyde, ammonia, and water on carbon Author(s): Lumeng Liu, Junjie Liu, Dingchao Zhang
	15:30	798	A Field Test of Decay Rates of Fluorescent Bioaerosols in Elementary School Author(s): Chunxiao Su, Josephine Lau
	15:30	800	Extraction of Dust Collected in HVAC Filters Author(s): Alireza Mahdavi, Jeffrey Siegel
	15:30	826	A verification of air purifying and humidifying performance of air purifier with mechanical ventilation Author(s): Dongryul Park

Day	Time	ID	Poster Session B: Comfort, Productivity, and Perception 4 (Chair: Elisa Van Kenhove)
Thurs 7/26	15:30	538	A new model of predicting thermal air quality based on adaptation Author(s): Deyu Kong
	15:30	540	Preferred temperature for occupants with standing and treadmill workstations Author(s): Siru Gao, Liu Yang, Hui Zhang, Yongchao Zhai
	15:30	566	Air pollution level in study areas as an indicator of the frequency of subjective complaints among students Author(s): Aneka Klavina
	15:30	581	Development of Korean comfort model for vehicle based on the field experiment Author(s): Yun Seoyeon, Chungyoon Chun, Jiyoung Kwak, Seokwon Seo, Chunkyu Kwon, Sanghun Kim
	15:30	608	Experimental study of the Air Thermal Parameters in the Wide-body Air-craft Cabins flight cruising in China Author(s): Hanyu Li, Junjie Liu, Congcong Wang, Jiayu Li
	15:30	658	Long-Term Field Measurements of Indoor Environmental Quality Performance of An Occupancy-Based Climate Control Technology Author(s): Hyojin Kim, Emily Oldham
	15:30	692	Thermal Comfort Assessment of The Bed Micro-environment Author(s): Mariya Bivolarova, Arsen Melikov, Hiroaki Ishizawa, Shintaro Kurasawa

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session C: Comfort, Productivity, and Perception 5 (Chair: Linda Hägerhed)
Thurs 7/26	15:30	695	Combined effect of hot ceiling and draught on thermal comfort Author(s): Balázs András, László Kajtár
	15:30	726	Measuring Comfort as a Building Control Parameter Author(s): Mark Luther, Steve Atkinson, Olubukola Tokede
	15:30	748	Advancing current post-occupancy evaluation approaches to effective indoor environmental quality designs and controls Author(s): Joon-Ho Choi, Kyeongsuk Lee, Marc Schiler, Selwyn Ting
	15:30	783	A Study on Perception for Risk Communication Channel Selection about Radon in Korea Author(s): Cheol Min Lee, Dae Ryong Kang, Tae Hyun Park, Si Hyun Park, Dan Gi Yoon, Hyung Jin Hong
	15:30	786	Analytical evaluation of thermal comfort implications from an expanded range of air temperatures and velocities Author(s): Hongshan Guo
	15:30	816	The effect of bedding fill on microclimate and thermal comfort during sleep Author(s): Ikue Mori, Kazuyo Tsuzuki
	15:30	241	Staff Satisfaction Survey – Is indoor air quality a critical factor? Author(s): Janice Green
	15:30	835	Evaluation of Outdoor Thermal Comfort in A Semi-Open Space Author(s): Yichen Yu, Jianlei Niu

Day	Time	ID	Poster Session D: Concentrations and Exposure 5 (Chair: Atze Boerstra)
Thurs 7/26	15:30	802	The actual population exposure of outdoor PM <sub>2.5</sub> -bound elemental carbon modified by infiltration in Beijing Author(s): Yangyang Xie, Bin Zhao
	15:30	491	Lung-deposited particle surface area (LDSA) and black carbon (BC) in high-rise apartments in Seoul, Korea Author(s): Donghyun Rim, Youngbo Won, Changhyeok Kim, Lee Seung-Bok, Gn Bae
	15:30	836	Indoor Air in Healing Environments: definition of a monitoring activity in inpatient wards for design and management strategies in healthcare facilities Author(s): Marco Gola, Stefano Capolongo, Gaetano Settimo, Veruscka Mannoni, Giorgio Padula, Marco De Felice
	15:30	595	Analysis on indoor air pollution in the dental clinics Author(s): Meng-Chieh Jeffrey Lee, Wu-Chen Shih
	15:30	849	Indoor air quality assessment in 38 ClimACT schools Author(s): S. Marta Almeida, Patrice Blondeau, Vitor Manteigas, Joana Lage, Ana D’Espiney, Marina Almeida-Silva, Nuno Canha, Karla Gonçalves, José Luís Alexandre, Ricardo Chacartegui, Jesus Lizana, José António Becera, Ana Gamarra, Yolanda Lechon Perez, Amaia Fernandes
	15:30	760	Distribution and sources of indoor and outdoor fine polycyclic aromatic hydrocarbons during winter and spring in Beijing Author(s): Mo Dan, Ding Ding, Mushui Shu
	15:30	549	Comparison of weekday and weekend hourly distribution of indoor ultrafine particulate matter (PM <sub>2.5</sub> ) concentrations with daily activity patterns in asthmatic children’s home in South Korea : Preliminary study results Author(s): Su Jung Park, Sung Roul Kim

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session E: Concentrations and Exposure 6 (Chair: Chunyi Wang)
Thurs 7/26	15:30	858	Assessment of Indoor Air Quality in Daycare Centers using Long-term Time Variation of Carbon Dioxide and Particulate Matter Measured by Monitoring Sensors Author(s): Yoonjee Kim, Sewon Lee, Hyunkyung Ban, Sagmin Cha, Geunbae Kim, Kiyoungh Lee
	15:30	860	A Study of Flame Retardants in Residential Furniture and Impact on Human Exposure and Flammability Author(s): Marilyn Black, Aika Davis, Debra Harris
	15:30	861	Indoor Dust Levels during Secondary School Cheerleading: Pilot Study Author(s): Laura Jones, Lauren Gonzalez, Derek Shendell
	15:30	862	PM10 during Secondary School Wrestling Practice and Matches: Pilot Study Author(s): Laura Jones, Lauren Gonzalez, Joseph Panchella, Derek Shendell
	15:30	201	Indoor exposure to total and soluble particle bound metals fractions in residential environment at 'world heritage site' Agra, India Author(s): Himanshi Rohra, Ajay Taneja
	15:30	872	Open-source hardware and software platform for energy and indoor environmental quality monitoring and control Author(s): Akram Ali, Brent Stephens
	15:30	874	Preliminary investigation of helium diffusion sampling for monitoring of indoor volatile organic compounds Author(s): Aurelie Laguerre, Jason Stenson, Kevin Van Den Wymelenberg, Elliott Gall
	15:30	875	Identify Multiple Outdoor Airborne Contaminant Sources with Mobile sensors: Unsteady Releasing Author(s): Yu Xue, Zhiqiang Zhai

Day	Time	ID	Poster Session F: Energy, Climate Change, and Policy 2 (Chair: Bjarne Olesen)
Thurs 7/26	15:30	475	Research on energy reduction methods using IoT (Internet of Things) Author(s): Jun Nakagawa, Yuka Maruyama, Tianshu Xu, Yugo Tsuneoka, Akihisa Nomoto, Ryoya Furukawa, Shingo Yamaguchi, Shinichi Tanabe, Takashi Akimoto
	15:30	478	Solar ventilated façade with PCM integration for air preheating Author(s): Andrei Bejan, Cristiana Croitoru, Mihnea Sandu, Ilinca Nastase, Florin Bode
	15:30	575	Indoor Air Quality Management Business Innovation: The Lean-Thinking Story Author(s): Moshood Fadeyi
	15:30	654	Field Test of the Earth Tube in a Subtropical Region Author(s): Jun-Ichiro Tsutsumi, Nakamatsu Ryu, Mamaru Matsuda, Fumio Kobayashi, Adrianus Bannepadang, Pascariant Bura
	15:30	734	Radon and Home Weatherization Assistance Author(s): Tess Bloom, Shelly Miller
	15:30	777	Post occupancy evaluation of a sports pavilion within an educational establishment Author(s): Emmanuel Essah, Sik Yin Ng
	15:30	782	Establishing the impact of occupant behaviour on energy reductions from a listed historic dwelling retrofit Author(s): Emmanuel Essah, Mollie Horton, Adrian Tagg
	15:30	869	Comparison of Outdoor, Indoor, and Personal PM2.5 Exposure between the Villages with/without Coal Burning in China Author(s): Xiaoying Li, Sierra Clark, Emily Floess, Jill Baumgartner, Tami Bond, Ellison Carter

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session G: Health Effects and Epidemiology 2 (Chair: Ray Palmer)
Thurs 7/26	15:30	369	Causal structures of association between home dampness during winter and allergic disease among children in cold climatic regions of Japan Author(s): Kenichi Hasegawa, Naoki Kagi, Jun Sakaguchi, Naohide Shinohara, Yasuyuki Shiraishi, Teruaki Mitamura, Nobuhiro Kanazawa
	15:30	371	Relationship between indoor temperature in winter and Brain Healthcare Quotient Author(s): Misa Matsumoto, Toshiharu Ikaga, Yoshinori Yamakawa, Yasufumi Uchida, Shuzo Murakami, Shintaro Ando, Yasue Mitsukura, Yukie Nakajima
	15:30	441	Voice Disorders in Teachers and Indoor Air Quality of School Buildings Author(s): Hanna Vertanen-Greis, Tuula Putus, Jukka Uitti, Eliisa Löyttyniemi
	15:30	682	Health Risk Assessment of Residential Characteristics and Indoor Air Quality of Naturally Ventilated Buildings in Nigeria Author(s): Marco-Felipe King, Oluwafemi Akande, Catherine Noakes
	15:30	717	Is the air that we breathe during sleep affecting our sleep quality? Author(s): Nuno Canha, Joana Lage, Joana Belo, Miguel Cruz, S. Marta Almeida, Célia Alves
	15:30	169	Investigation of association between indoor environment and elderly's cardio-cerebrovascular disease in China – Design and preliminary outcome Author(s): Hiroshi Yoshino, Huibo Zhang, U Yanagi, Kenichi Hasegawa, Tomonobu Goto, Naoki Kagi, Qingyuan Zhang

Day	Time	ID	Poster Session H: Microbiology and Dampness 1 (Chair: Jordan Peccia)
Thurs 7/26	15:30	186	Discussion of the impacts of damp and exhausting in the bathroom Author(s): Meng-Chieh Lee
	15:30	183	This Hospital is A Scary Place - Aspergillus fumigatus Exposures in a 5 Story Cancer Treatment Facility Author(s): Michael McGuinness, Charles McGuinness
	15:30	413	Everyday behavior and prevention of mold and dampness in dwellings Author(s): Lars Gunnarsen, Kasper Olsen, Sirid Bonderup
	15:30	838	The carbon dioxide concentration, temperature and humidity impact analysis on the quantity of units which can create fungus Author(s): Dorota Koruba
	15:30	711	Exposure to particles and microorganisms in a dental office Author(s): Bernard Polednik, Adam Piotrowicz, Lukasz Guz, Marzenna Dudzinska
	15:30	25	The Dangers of Not Understanding and Properly Maintaining of Cold Rooms Used to Support Medical Research Author(s): Anthony Chibbaro, Evan Rousseau
	15:30	714	Detection of Early Changes in Building Materials Using MVOC and FTIR Analyses to Aid in Mold and Moisture Remediation Author(s): Jacob Mensah-Attipoe, Pertti Pasanen, Marko Hyttinen, Arto Koistinen, Jari Leskinen
	15:30	550	Distribution of indoor damp index levels obtained from Korean asthmatic patients' houses: Preliminary study results Author(s): Su Jung Park, Sung Roul Kim

## Detailed Technical Program

Thursday, July 26<sup>th</sup>

### Afternoon Poster Sessions – Ballroom B (15:30 – 17:30)

Day	Time	ID	Poster Session I: Sources and Emissions 4 (Chair: Yuexia Sun)
Thurs 7/26	15:30	670	Investigation of the quantity of exhaled aerosols released into the environment during jet nebulization Author(s): James McGrath, Gavin Bennett, Ciarrai O Toole, Miriam Byrne, Mary Joyce, Ronan Macloughlin
	15:30	679	Tobacco Heating System vs Cigarette: Comparison of Aerosol Concentrations in a Simulated Room Environment Author(s): Violeta Kauneliene, Marija Meisutovic-Akhtarieva, Darius Ciuzas, Tadas Prasauskas, Karolina Keraitytė, Dainius Martuzevicius
	15:30	757	Effect of Radiant Cooling on Indoor TVOC Concentration Distribution Author(s): Yuan Liu
	15:30	763	Emissions Associated with Misapplied Spray Polyurethane Foam Author(s): Ed Light, Paul Haas
	15:30	636	Determining Radon Entry Rates into Residential Dwellings: Parameterisation Data for Radon Models Author(s): Miriam Byrne, James McGrath
	15:30	863	VOC exposure in Belgian dwellings – evaluation with a temperature and humidity based emission model Author(s): Klaas De Jonge, Arnold Janssens, Jelle Laverge
	15:30	865	Simmering Sauces! Elevated Formaldehyde Concentrations from Gas Stove Burners Author(s): Dustin Poppendieck, Mengyan Gong
	15:30	880	Formation of Low-Volatility Products in Reactions of Carbonyl Oxide Criegee Intermediates Author(s): Rebecca Caravan, Arkke Eskola, Ivan Antonov, Frank Winiberg, Brandon Rotavera, Krupa Ramasesha, Leonid Sheps, David Osborn, Carl Percival, Dudley Shallcross, Craig Taatjes

Day	Time	ID	Poster Session J: Ventilation and HVAC Systems 4 (Chair: Mohammad Heidarinejad)
Thurs 7/26	15:30	784	Research on influence factors of unorganized fresh air in subways Author(s): Yue Zhang, Xiaofeng Li
	15:30	793	An Investigation of Control Strategy Approach of Heat Pump in a Dehumidification System Author(s): Chih-Neng Hsu
	15:30	812	Is the thermal comfort and ventilation of New Zealand (NZ) classrooms following the newly-released requirements? Author(s): Yu Wang, Mikael Boulic, Robyn Phipps, Manfred Plagmann, Chris Cunningham, Chris Theobald, Philippa Howden-Chapman, Michael Baker
	15:30	817	Heat Exchange Performance of High Efficiency Heat Pump System Author(s): Chih-Neng Hsu
	15:30	818	Natural Ventilation Rates through Windows in Homes Author(s): Hyewon Yeom, Junseok Park
	15:30	820	Effect of ventilation on indoor particle and CO <sub>2</sub> concentration in public transport buses Author(s): Seong Eun Woo, Junseok Park, Seung Woo Bang, Namseok Yun
	15:30	687	Enhancement of capture velocity with an annular slotted-hood Author(s): Wenhua Chen, Junjie Liu, Yunxia Chen, Jiahua Wang
	15:30	877	Modeling the energy impacts of underground garage ventilation strategies Author(s): Afshin Faramarzi, Mohammad Heidarinejad, Brent Stephens



## Detailed Technical Program

Friday, July 27<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Chemistry and Transformations 5: Oxidants and NO <sub>x</sub> Chairs: Ray Wells, Jensen Zhang Room 201A
Fri 7/27	10:30	228	The fate of OH and RO <sub>2</sub> radicals in presence of TiO <sub>2</sub> nanoparticles embedded in paints Author(s): Adrien Gandolfo, Sasho Gligorovski, Hui Chen, Alexandre Kukui, Henri Wortham, Amandine Durand, Brice Temime-Roussel
	10:45	742	Time-resolved Characterization of Indoor Oxidants in a New York Home Author(s): Shan Zhou, Cora Young, Trevor Vandenboer, Tara Kahan
	11:00	346	Changes in outdoor pollutant concentrations and environmental conditions along the height of a tall building Author(s): Parham Azimi, Haoran Zhao, Torkan Fazli, Dan Zhao, Afshin Faramarzi, Luke Leung, Brent Stephens
	11:15	352	Nucleation of Ultrafine Particles Arising from Oxidation of Cigarette Smoke in Indoor Environments Author(s): Chen Wang, Douglas Collins, Rachel Hems, Nadine Borduas, María Antiñolo, Jonathan Abbatt
	11:30	392	Measuring the penetration factor of outdoor NO <sub>2</sub> and NO <sub>x</sub> in an unoccupied apartment unit Author(s): Haoran Zhao, Brent Stephens
	11:45	879	The Interaction Between Indoor Relevant Organic Compounds on Silica Surfaces at Different Relevant Humidities Author(s): Yuan Fang, Andrew McDonald, Vicki Grassian

Day	Time	ID	Concentrations and Exposure 9: Residential Environments Chairs: Chun Chen, Shelly Miller Room 204A
Fri 7/27	10:30	681	Time-resolved exposure to volatile organic compounds in two California residences Author(s): Pawel Misztal, Yingjun Liu, Yilin Tian, Caleb Arata, Kasper Kristensen, David Lunderberg, Jianyin Xiong, William Nazaroff, Allen Goldstein
	10:45	340	Predicting Indoor Concentrations of Black Carbon in Residential Environments Author(s): Kelechi Isiugo, Roman Jandarov, Jennie Cox, Julian Wang, Marko Hyttinen, Michael Yermakov, Tiina Reponen
	11:00	422	Impact of Environmental Factors on Radon Author(s): Paul Francisco, Leslie Stoecker, Beth Hall, Stacy Gloss, Yigang Sun, William Rose, Zach Merrin
	11:15	472	Indoor/outdoor relationship of fine and ultrafine particles: A study of 20 private dwellings in Germany Author(s): Wolfram Birmili, Jiangyue Zhao, Birgit Wehner, Thomas Tuch, Kay Weinhold, Maik Merkel, Ulrich Franck, Anja Lüdecke, Tareq Hussein, Alfred Wiedensohler
	11:30	629	Temporal and Spatial Variability of Multiple Contaminants in a Residence Author(s): Yigang Sun, Paul Francisco, Tami Bond, Vishal Verma, Thanh Huong Nguyen
	11:45	660	A Review of Contaminant Concentrations in Social Housing Author(s): Ernesto Diaz Lozano Patino, Jeffrey Siegel

## Detailed Technical Program

Friday, July 27<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Energy, Climate Change, and Policy 2: IAQ Policies and Standards Chairs: Chungyoon Chun, Bill Bahnfleth Room 204B
Fri 7/27	10:30	504	Managing the indoor environmental needs of hospital occupants: a facilities management perspective Author(s): Prachi Garnawat, Jin Woo, James PC Wong, Mary Myla Andamon
	10:45	164	Tightening Standards for Indoor Levels of PM2.5: A Promising Approach for Reducing PM2.5 Associated Mortalities in Urban China Author(s): Jianbang Xiang, Charles Weschler, Jinhan Mo, Junfeng (Jim) Zhang, Yinping Zhang
	11:00	452	RTS GLT-Environmental Classification -Experiences and New Developments Author(s): Laura Sariola, Timo Rintala, Jorma Säteri
	11:15	637	National and International IEQ Guidelines Author(s): Ulla Haverinen-Shaughnessy, Ian Cull, Lars Gunnarsen, Linda Hägerhed, Kiyong Lee
	11:30	822	Updated Constructional Guidelines for Implementation of Healthy Building in Remediation in Finland Author(s): Tero Marttila
	11:45	532	An overview of indoor air quality and ventilation standards in commercial buildings and aircrafts Author(s): Erica Zavaglio, Mathieu Le Cam, Giusi Quartarone, Catherine Thibaud

Day	Time	ID	Health Effects and Epidemiology 3: Health Indicators Chairs: Donald Milton, Ellison Carter Room 201C
Fri 7/27	10:30	285	Exposures to Particle Gamma Activity and Biomarkers of Systemic Inflammation and Endothelial Activation in COPD Patients Author(s): Shaodan Huang, Petros Koutrakis, Carol Vieira
	10:45	302	Toxicity Screening of Volatile Chemicals Using a Novel In Vitro Exposure System: Transcriptomic Analysis in Human Lung Cells Author(s): Jose Zavala, Ryan Collins, Lisa Dailey, Nancy Hanley, Q. Todd Krantz, Paul Evansky, Josh Harrill, Mark Higuchi
	11:00	319	Analysis of the Relationship between Proportion of Well-insulated Homes and Excess Winter Mortality Based on Statistical Information in Japan Author(s): Takuro Ishito, Toshiharu Ikaga, Shun Kawakubo
	11:15	354	Effectiveness of Portable Indoor Air Cleaners for Removal of Indoor Pollutants and Associated Biomarker Changes Author(s): Howard Kipen, Qingyu Meng, Kathy Black, Robert Laumbach, Charles Weschler, Shahnaz Alimokhtari
	11:30	367	Estimates of the U.S. Mortality Burden Attributable to Exposure to Fine Particulate Matter in Indoor and Outdoor Microenvironments Author(s): Parham Azimi, Brent Stephens
	11:45	487	Indoor air pollutant screening in office buildings: a differentiated risk approach Author(s): Guillaume Sérafin, Patrice Blondeau, Corinne Mandin

## Detailed Technical Program

Friday, July 27<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Microbiology and Dampness 5: Moisture Impacts Chairs: Martin Täubel, Miia Pitkäranta Room 201B
Fri 7/27	10:30	490	Relating Moisture Content of Gypsum Board, as Measured by Multiple Moisture Meters, to Water Activity Author(s): Mark Mendell, Rachel Adams, Wenhao Chen, Kazukiyo Kumagai, Janet Macher
	10:45	576	Longitudinal assessment of classroom microbiota in relation to moisture damage and dampness Author(s): Martin Täubel, Rachel Adams, Hanna Leppänen, José Jacobs, Juha Pekkanen, Jan-Paul Zock, Dick Heederick, Anne Hyvarinen
	11:00	772	Gypsum Response to Liquid Water Wetting in Indoor Environments Author(s): Phil Fan, Claire Lepine, Jeffrey Siegel
	11:15	819	Determinants of measured moisture and observed dampness in New Zealand homes Author(s): Phoebe Taptiklis, Robyn Phipps, Jeroen Douwes, Mark Jones
	11:30	759	Control of Humidity-Related Mold Growth in Unoccupied Schools Author(s): Ed Light, James Bailey
	11:45	611	Mould exposure in indoor environments: The French ANSES recommendations to reinforce measures for preventing mould growth and the impact on human health Author(s): Guillaume Boulanger, Marion Keirsbulck, Clemence Fourneau, Thomas Bayeux, Valérie Bex, Anne-Claire Colleville, Alain Ginestet, Bénédicte Leynaert, Christina Aschan-Leygonie, Denis Caillaud, Emilie Frealle, Gabriel Reboux, Isabelle Oswald, Laurence Le Coq, Rachel Nadif, Sandrine Roussel, Stéphane Bretagne

Day	Time	ID	Sources and Emissions 7: Field Studies Chairs: Joel Harrison, Francis Offermann Room 204C
Fri 7/27	10:30	378	Attached Garage Contaminant Transport and Intervention Results Author(s): Zach Merrin, Paul Francisco
	10:45	391	Assessment of VOC source contributions in newly built timber frame houses using the chemical mass balance model Author(s): Herve Plaisance, Pierre Mocho, Nicolas Sauvat, Jane Vignau-Laulhere, Katarzyna Raulin, Valérie Desauziers
	11:00	397	Contributions of indoor and outdoor sources to fluorescent particle exposure in a residence Author(s): Yilin Tian, Yingjun Liu, Pawel Misztal, Kasper Kristensen, Caleb Arata, David Lunderberg, Allen Goldstein, William Nazaroff
	11:15	406	Spatially and temporally resolved emissions of volatile organic compounds in a residence Author(s): Yingjun Liu, Pawel Misztal, Jianyin Xiong, Yilin Tian, Caleb Arata, William Nazaroff, Allen Goldstein
	11:30	738	Ozone and Ultrafine Particle Emission Rates in University Copy Rooms Author(s): Jonathan Gingrich, Heidi Salonen, Michael Wade, Luke Snell, Atila Novoselac, Richard Corsi
	11:45	752	Soil Vapor Intrusion of 1,4-Dioxane Measured using Passive Sampling and Thermal Desorption and GC/MS Author(s): Nan Lin, Lexuan Zhong, Christopher Godwin, Stuart Batterman

## Detailed Technical Program

Friday, July 27<sup>th</sup>

### Morning Podium Sessions – 200 level rooms (10:30 – 12:00)

Day	Time	ID	Symposium 23: Clothing and other textiles as mediators of personal exposure to indoor pollutants Chairs: Glenn Morrison, Charles Weschler, Gabriel Bekö, Tunga Salthammer, Dusan Licina Room 202A
Fri 7/27	10:30	382	Dermal uptake of benzophenone-3 from clothing: comparison of model to human participant results Author(s): Azin Eftekhari, Glenn Morrison
	10:45	704	Inhalation and dermal uptake of particle and gas phase phthalates - a human chamber exposure study Author(s): Christina Andersen, Annette Kraus, Axel Eriksson, Joans Jakobsson, Jakob Löndahl, Christian Lindh, Joakim Pagels, Jörn Nielsen, Anders Gudmundsson, Aneta Wierzbicka
	11:00		Discussion and summary
	11:15	198	Removing adhered particles from cloth surface with a mechanical strike Author(s): Liming Niu, Jihong Wang, Tengfei Zhang, Shugang Wang
	11:30	189	Clothing as collector and emitter of airborne inhalable particles Author(s): Dusan Licina, William Nazaroff
	11:45		Discussion and summary

Day	Time	ID	Workshop 5: Measurement and experimental challenges in sleep related IAQ studies Chairs: Jelle Laverge, Richard Corsi, Zhiwei Lian, Brandon Boor, Pawel Wargocki Room 202B
Fri 7/27	10:30	312	Effect of Sleep Quality Based on Sleep Stage on the Next-day Performance in the Morning and Afternoon Author(s): Yuka Takeuchi, Yuichi Akiyama, Risa Inoue, Masayuki Ogata, Riho Matsuzaki, Junichi Asaka, Mika Saito, Kazuyo Tsuzuki, Shinichi Tanabe
	10:45	445	Effects of the thermal environment in bedrooms on sleep considering the change in clothing insulation Author(s): Risa Inoue, Yuichi Akiyama, Yuka Takeuchi, Masayuki Ogata, Mika Saito, Junichi Asaka, Kazuyo Tsuzuki, Shinichi Tanabe, Riho Matsuzaki
	11:00		Workshop
	11:15		
	11:30		
11:45			

## Detailed Technical Program

Friday, July 27<sup>th</sup>

### Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Energy, Climate Change, and Policy 3: Energy, Climate, and IEQ Chairs: Paul Francisco, Melissa Bilec Room 204A
Fri 7/27	13:30	181	A tool to quantify emission reductions and climate/health co-benefits from building energy use reductions Author(s): Xiaodong Cao, Piers Macnaughton, Jonathan Buonocore, Jose Cedeno Laurent, Joseph G. Allen
	13:45	234	Impact of outdoor climate and ambient air pollution on indoor air quality Author(s): Tunga Salthammer, Alexandra Schieweck, Jianwei Gu, Shaghayegh Ameri, Erik Uhde
	14:00	804	Assessing the Potential Impact of Climate Change on Particle Infiltration in Two US Cities: Boston, MA and Atlanta, GA Author(s): Wan-Chen Lee, Donghai Liang, Joy Lawrence, Jeremy Sarnat, Stephanie Sarnat, Loretta Mickley, Petros Koutrakis
	14:15	625	Investigating the Relationship between Transportation and Building Energy Use in Philadelphia Households Author(s): Shideh Shams Amiri, Nariman Mostafavi, Earl Lee, Simi Hoque
	14:30	433	Energy consumption analysis of railway passenger stations in various climate regions in China Author(s): Ziyi Su, Xiaofeng Li
	14:45	195	Balancing Indoor Air Quality and Energy Efficiency, District-scale Improvements with Life Cycle Benefits Author(s): Harold Rickenbacker, William Collinge, Melissa Bilec

Day	Time	ID	Health Effects and Epidemiology 4: Synthesis Studies Chairs: Stuart Batterman, Geo Clausen Room 201C
Fri 7/27	13:30	111	Associations of Household Dampness-related Exposures with Adverse Birth Outcomes in China: A National Retrospective Observational Study Author(s): Wei Liu
	13:45	255	A Review of How Home Ventilation Rates Affect Health Author(s): William Fisk
	14:00	533	Indoor Environmental Quality, Pupil's Health and Academic Performance: A Summary of Work Done in Finland, USA and Nigeria Author(s): Oluyemi Toyinbo, Richard Shaughnessy, Ulla Haverinen-Shaughnessy
	14:15	632	An updated review of IAQ and health outcomes of air cleaner use in homes Author(s): Brent Stephens, Lew Harriman, Terry Brennan, Vito Ilacqua
	14:30	256	A Review of Associations of Dampness and Mold at Schools with Cough, Wheeze, and Nasal Symptoms Author(s): William Fisk
	14:45	653	What do Participants in a Birth Cohort Study Know About Their Homes? Author(s): Claire Lepine, Jeffrey Siegel, James Scott, Malcolm Sears, Jeffrey Brook, Tim Takaro, Padmaja Subbarao, Allan Becker, Piushkumar Mandhane, Stuart Turvey, Diana Lefebvre

## Detailed Technical Program

Friday, July 27<sup>th</sup>

### Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	ID	Microbiology and Dampness 6: Future Steps Chairs: Karen Dannemiller, Tiina Reponen Room 201B
Fri 7/27	13:30	824	A Call for Guidelines to Forward Consensus on Executing Indoor Microbiome Surveys Author(s): Hal Levin, Mark Hernandez
	13:45	652	Microbiomes of the Built Environment: A Research Agenda Author(s): Katherine Bowman, David Butler, Elizabeth Boyle
	14:00	306	Low-cost particle sensors: performance evaluation for indoor bioaerosols Author(s): Parichehr Salimifard, Donghyun Rim, James Freihaut
	14:15	407	A Preliminary Study of Microbiome on HVAC Air Filters Author(s): Peihua Wang, Yuguo Li, Patrick Lee
	14:30	494	Association between Current Asthma and 36 Fungal Taxa in Residential Dust Analyzed by Quantitative PCR: A Review Author(s): Pei Yang Hsieh, Mark Mendell
	14:45	368	The Metagenomics Analysis of Air, Dust and Surfaces of Tropical Buildings Author(s): Kenny Jia Xu Lau, Akira Uchida, Irvan Luhung, Serene B. Y. Lim, Stephan Schuster

Day	Time	ID	Ventilation and HVAC Systems 7: Residential Ventilation and Infiltration Chairs: Parham Azimi, James Lo Room 204B
Fri 7/27	13:30	400	Improved Sealing of Attached Garages Reduces Infiltration of Polluted Air into Adjoining Dwelling Spaces Author(s): Daniel Aubin, Gary Mallach, Melissa St-Jean, Tim Shin, Keith Van Ryswyk, Ryan Kulka, Hongyou You, Don Fugler, Eric Lavigne, Amanda Wheeler
	13:45	751	Long-term Air Exchange Rates in a Residence Author(s): Masih Alavy, Jeffrey Siegel
	14:00	645	Impacts of HVAC Sequencing on Runtime Author(s): Tianyuan Li, Jeffrey Siegel
	14:15	578	Estimating Effective Ventilation Rates in Rural Homes Using Polluting Fuels Author(s): Ellison Carter, Vatsal Gupta, Khishigbayar Jamiyansharav, Heather Adair-Rohani, Jessica Lewis, Michael Johnson
	14:30	180	Indoor air toxic gases levels in a net-zero energy house under multiple ventilation system settings Author(s): Yibo Huangfu, Nathan Lima, Patrick O'Keeffe, Beiyu Lin, Diane Cook, Von Walden, William Kirk, Shelley Pressley, Brian Lamb, Bertram Jobson
	14:45	584	Development of a Natural Soil Depressurization System Sizing Tool Author(s): Marc Abadie, Zaid Romani, Michel Burlot, Jérôme Nicolle, Pierre Peigné, Lionel Druette, Bernard Collignan, Francis Allard

## Detailed Technical Program

Friday, July 27<sup>th</sup>

Afternoon Podium Sessions – 200 level rooms (13:30 – 15:00)

Day	Time	Workshop 6: Ventilation and Transmission of Influenza and other Respiratory Viruses Chairs: Donald Milton, Jelena Srebric Room 201A	
Fri 7/27	13:30	Workshop	
	13:45		
	14:00		
	14:15		
	14:30		
	14:45		

Day	Time	ID	Workshop 7: Translating sleep IEQ research into new residential ventilation standards Chairs: Jelle Laverge, Brandon Boor, Pawel Wargocki, Zhiwei Lian, Atila Novoselac, Nuno Canha Room 202A
Fri 7/27	13:30	730	Indoor air quality during sleep Author(s): Nuno Canha, S. Marta Almeida
	13:45	775	Energy efficient reduction of exposure to airborne particles while sleeping Author(s): Jordan Clark, Richard Corsi, Atila Novoselac
	14:00	Workshop	
	14:15		
	14:30		
	14:45		

Day	Time	Workshop 8: Healthy building with the WELL building standard Chairs: Atze Boerstra, Bjarne Olesen Room 204C	
Fri 7/27	13:30	Workshop	
	13:45		
	14:00		
	14:15		
	14:30		
	14:45		