# Abstract

Quantum metrology is a research field that deals with enhancing the resolution or sensing capabilities of a system which is otherwise constrained by classical limits. Improvements in measurements have historically led to new scientific discoveries, the recent example being the gravitational wave detection. Thus, quantum metrology could be an avenue for enabling scientific breakthroughs. In the present thesis, I have reported a first feasibility test of quantum enhanced correlated phase interferometry. A result that, on the other hand, paves the way for developing a new field of Quantum metrology and on the other hand, could be applied to the detection of fundamental stochastic noises such as Holographic noise, gravitational wave background or traces of primordial black holes. The experiment was performed injecting two types of quantum states, namely the squeezed states and a twin-beam like state, in a system consisting of two co-located power recycled Michelson interferometers. When two independent squeezed states were injected, we were able in detecting a faint test correlated phase signal with an amplitude several orders of magnitude below the shot noise limited sensitivity of a single interferometer. The joint sensitivity obtained for the double interferometric system with squeezed states injected was $(3.21 \pm 0.16) \times 10^{-17} \frac{m}{\sqrt{Hz}}$ around 13.5 MHz, in a few seconds of measurement time. The second phase of the experiment involved the injection of a bipartite quantum correlated state in the two interferometers. In this case, we have demonstrated a quantum advantage in detecting uncorrelated noise or difference in the two interferometers' signals enabled by the reduction of the noise in the output photocurrent subtraction.