Summary

In this thesis we will focus on describing results concerning both String theory and Supergravity. To this end, this thesis will be divided into two parts. In the first one we will address the problem of background independence in the open superstring context by first reviewing the needed mathematical formalism, starting from 2-d Conformal Field Theories and continuing with Open String Field Theory and Witten's cubic approach.
In particular, we will focus on studying the properties of the intertwining solution of the cubic equations of motion, which in general allow to describe any D-brane system, starting from a known one. The solution will be analysed from the point of view of OPE divergences and anomalous products of boundary condition changing operators.

The second part of this thesis will instead focus on Supergravity results: we will start by reviewing the geometric approach including it in the Principal bundle formalism of differential geometry. We will then continue by describing one application of this formalism to N-extended AdS Supergravity and its relation to the description of the electronic properties of graphene-like materials. We will indeed be able to obtain massive Dirac equations describing charge carriers behaviour near Dirac points. This result will be further improved by introducing a light-cone transformation mechanism, capable to introducing the correct Fermi velocity in the description of the obtained model.
We will then end by studying the holographic properties of the N=2 theory, which constitutes a first step towards understanding the obtained graphene model in the context of the AdS/CFT conjecture.