Fernando Marchesano
& Wieland Staessens

Master Projects 2017-2018

1 Magnetic Monopoles and the Weak Gravity Conjecture

Abstract:
The introduction of the string landscape leads to the natural question which field theories couple consistently to quantum gravity and which ones risk to fall into the infertile *swampland*. Our limited understanding of quantum gravity makes it challenging to propose stringent criteria to probe which field theories can be UV-completed with gravity. Yet there exists a well-argued touchstone going under the name of the Weak Gravity Conjecture (WGC), which roughly speaking asserts that gravity is the weakest force. In this project, the student will test the WGC for string theory compactifications with D-branes, by studying the magnetic monopoles for the gauge theories supported by D-branes.

Plan of the project:

1. Study of Magnetic Monopoles and WGC
2. Study of D-branes
3. Investigation of the magnetic poles for gauge theories on D-branes

Techniques/Tools used: Mathematica, Paper & Pen

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2 Wormholes and Large Field Inflation

Abstract:
One of the major challenges in string cosmology consists in constructing a fully consistent model of large field inflation with measurable tensor modes. Such models are often constrained by gravitational corrections that destroy the inflationary plateau. One of those gravitational corrections comes from axionic wormholes, which are solutions the Euclidean Einstein equations coupled to a scalar field (axion). In string theory the parameters appearing in the lagrangian for the axion depend on other, heavier scalar fields, which might alter the present understanding of axionic wormholes. In this project, the student will investigate such string-inspired scenarios and construct the corresponding wormhole solutions. The results of these computations will for sure have something to say about the viability of large field inflation in our universe.

Plan of the project:

1. Study of Axionic Wormholes
2. Study of large field inflationart models
3. Investigation of the axionic wormholes with moduli-dependent parameters

Techniques/Tools used: Mathematica, Paper & Pen