

# Nathan Moynihan

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## EDUCATION

### UNIVERSITY OF CAPE TOWN

#### PHD IN APPLIED MATHEMATICS

Quantum Gravity & Strings Lab  
Ongoing (2nd year) | Cape Town, SA

### KINGS COLLEGE LONDON

#### MSCI IN PHYSICS (1<sup>ST</sup> CLASS)

2010-2014 | London, UK  
4-year average of 83/100.

## COURSES

### 3RD YEAR

Mathematical Methods in Physics . . . .	94
Statistical Mechanics . . . . .	90
Spectroscopy/Quantum Mechanics . . .	94
Particle Physics . . . . .	93
Optics . . . . .	91
Solid State Physics . . . . .	74
General Relativity and Cosmology . . . .	98

### 4TH YEAR

Standard Model Physics and Beyond . .	78
Advanced Quantum Theory . . . . .	72
Quantum Field Theory . . . . .	88
Advanced Quantum Field Theory . . . .	65
Advanced Cosmology . . . . .	79
Relativity and Gravitation . . . . .	89

## ATTENDED

**2014** European Summer School on Spontaneous Symmetry breaking. Presented a poster titled 'Why is the Universe made only of matter?'

**2016** ICTP Spring School on Superstring Theory and Related Topics

**2016** Workshop on Topics in Three Dimensional Gravity

**2016** 7th Joburg Workshop on String Theory

**2017** The First Mandelstam Theoretical Physics School and Workshop

CV Last Updated 1st April 2017

## RESEARCH

### PHD (ONGOING)

#### AMPLITUDES, ENTANGLEMENT ENTROPY AND THE WEB OF DUALITIES

2015 - Ongoing

My current research is divided into two main areas: modern scattering amplitude method - for example BCFW recursion, BCJ duality, CHY amplitudes etc, with a special focus on understanding gravity. The second is looking at entanglement entropy and other information theoretic quantities in quantum field theories, in particular trying to understand how these quantities hold up under various dualities.

### MASTERS PROJECT

#### LEPTOGENESIS IN A BACKGROUND KERR GEOMETRY AS AN EXPLANATION FOR THE BARYON ASYMMETRY PROBLEM

2014 | Supervisor: Prof Nick Mavromatos

This project involved exploring the possibility that Leptogenesis at an early stage of the Universe could have been induced by non-trivial geometries. In essence, this involved coupling fermions to a background geometry (Kerr, Bianchi) and studying the production rates of particles vs antiparticles. Mathematica was used extensively to calculate vierbeins and the spin connection etc, a package I wrote specifically for this task is available on github.

### LITERATURE REVIEW

#### PARTICLE PHYSICS OF THE STANDARD MODEL AND BEYOND

2013 | Supervisor: Dr Bobby Acharya

The literature review involved writing a brief overview of the standard model of particle physics, including the Higgs mechanism and its detection. The focus of the review was to critically appraise some of the theories beyond the standard model and to see if they can go some way to explaining anomalous results surrounding the recent Higgs particle discovery at the LHC. The main theories focused upon were the MSSM and NMSSM, both theories based on the idea of supersymmetry. It was found that the NMSSM more naturally explains the results where as the MSSM would require some adjustment in order to agree with experiment.

## RESEARCH INTERESTS

- Modern Amplitude methods (BCFW, CHY etc) and what they can tell us about gravity
- Entanglement entropy and other information theoretic quantities in QFT and Gravity
- Features of low dimensional QFTs - bosonisation, particle-vortex dualities, anomalies.
- The black hole information paradox and its most recent approaches (Complementarity, Firewalls, ER = EPR)
- The classical double copy - applying the BCJ duality classical theories.
- Quantum Gravity - Topological, Massive, 3D etc

## AWARDS

### Nelkon Prize

Awarded to the single student with the best academic performance in the final examinations of the final (undergraduate) year in physics.

### Gordon Rogers Scholarship

A £3,000 scholarship awarded to the five MSc students with the best academic record