Imperial College London

Theoretical Physics Postgraduate Open Day

15 January 2014
Imperial College

- Science, Technology and Medicine
- Founded in 1907
### World University Rankings 2013-2014

<table>
<thead>
<tr>
<th>Rank</th>
<th>Institution</th>
<th>Location</th>
<th>Overall score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>California Institute of Technology (Caltech)</td>
<td>United States</td>
<td>94.9</td>
</tr>
<tr>
<td>2</td>
<td>University of Oxford</td>
<td>United Kingdom</td>
<td>93.9</td>
</tr>
<tr>
<td>3</td>
<td>Harvard University</td>
<td>United States</td>
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<td>4</td>
<td>Stanford University</td>
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<tr>
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<td>12</td>
<td>University of California, Los Angeles (UCLA)</td>
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<td>86.3</td>
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Theory Group in 1964
Theory Group

- **String Theory**
  - Prof J. Gauntlett (HoG)
  - Prof M. Duff FRS
  - Prof A. Hanany
  - Prof C. Hull FRS
  - Prof K. Stelle (MSc dir)
  - Prof A. Tseytlin
  - Prof D. Waldram
  - Dr T. Wiseman (PhD adm)

- **Quantum Foundations**
  - Prof J. Halliwell
  - Prof F. Dowker
  - Prof C. Isham

- **Quantum Field Theory**
  - Dr T. Evans
  - Prof A. Rajantie (MSc adm)
  - Prof R. Rivers
  - Dr H. Jones

- **Cosmology**
  - Prof J. Magueijo
  - Prof C. Contaldi
  - Prof T. Kibble CBE FRS

Postdocs and Visitors (14)
PhD students (21)
MSc students (37)
MSc in Quantum Fields and Fundamental Forces

- Preparation for PhD studies in fundamental theoretical physics:
  - Theory, techniques, applications
  - Graduate-level lectures (attended also by PhD students)
  - Research skills: Dissertation project

- Full MSc course under Bologna system:
  - 12 months full time / 24 months part time
  - 90 ECTS credits
Routes to PhD

1. MSci (4 years) → PhD
2. BSc (3 years) → MSc → PhD
3. MSci (4 years) → MSc → PhD
4. Msci or BSc → work → MSc → PhD
MSc in Quantum Fields and Fundamental Forces

- Around 40 students
- International:
  Roughly 1/3 UK, 1/3 EU, 1/3 overseas
- Focus on fundamental theory
- Lectures mostly in this room
- Informal interactions with academic/research staff
Quantum Field Theory
Today's Lesson: $W_0$ or "Witten's Dog"

Neutron Encrusted
Steaming Hot
Dark Matter

Superdupsersymmetric
String Theory
Cosmology and General Relativity
Quantum Mechanics
Lecture Courses

- Compulsory
  - Particle Symmetries
  - Quantum Field Theory
  - Quantum Electrodynamics
  - Unification – the Standard Model

- Optional (≥4)
  - Advanced QFT
  - Black Holes
  - Differential Geometry
  - Particle Cosmology
  - String Theory
  - Supersymmetry
  - Foundations of QM (UG)
  - General Relativity (UG)
  - Group Theory (UG)
  - Quantum Information (UG)
  - Quantum Theory of Matter (UG)
  (at most 2 UG courses)
Timetable

- Dissertation
- Compulsory Courses + Some Options
- Christmas Break
- New Year Tests
- Optional Courses
- Easter Break
- Exams
- Special Topics Lectures
Seminars and Special Topics Lectures

- Departmental Colloquium
- Theory Group Seminar
  (+ Several specialised seminar series)
- Special Topics Lectures in June
  - Last year: AdS/CFT
    Causal Set QFT
    Generalised Geometry
    Inflation & Non-Gaussianity
    Lattice Field Theory
    Magic Squares from (YM)^2
    Supersymmetry & Localisation
Dissertations

- From June to September
- Supervised by a faculty member
  - Usually related to their own research
- You decide the topic with your supervisor:
  - No fixed list of topics
Last Year's Dissertations

- A Numerical Study of the Quantum Backflow Effect
- A review of the AdS/CFT Duality
- A Review of the N=4 Super Yang-Mills / Type IIB AdS/CFT correspondence
- Bimetric Models of Gravity and Cosmology in the Early Universe
- Born-Infeld Action and Its Applications
- Causal Sets from Classical Sequential Growth Models
- Collapse Theory
- Confinement and the String Tension in Hot Yang Mills
- Cyclic Universe: Cosmic Evolution and Perturbations Analysis
- Defining a mean on Lie groups
- Division Algebras, Magic Squares and Supersymmetry
- Effective Field Theories for Inflation
- Formation of Topological Defects from Symmetry-breaking Phase Transitions in Ion chains, Superconductors & Josephson Junctions
- Generalized Geometry and Double Field Theory
- Generalized Geometry and the NS-NS Sector of Type II Supergravity
- Generalized Geometry, Parallelizability and Non Geometry
- Higher Derivative Theories of Gravity
- Holographic Principle and Applications to Fermion System
- Integrability and the AdS/CFT Correspondence
- Integrable Systems with Uq(sl2) and su(2|2) symmetry
- Kaluza-Klein Theory in Quantum Gravity
- Measurable and Immeasurable in Relativistic Quantum Information
- Mirror Symmetry in 3d supersymmetric gauge theories
- N=4 Gauge Theories in 3D, Hilbert Series, Mirror Symmetry and Enhanced Global Symmetries
- Octonionic Aspects of Supergravity
- R-Parity Violation and Neutrino Mass
- Spin systems on causal sets
- Spontaneous and induced false vacuum decay
- Study of QED radiative corrections to charged lepton leg in neutrino-nucleon interactions
- The AdS/CFT correspondence and applications to QCD
- The Backflow Effect
- The Black Hole Firewall Paradox
- The Causal Set Approach to Quantum Gravity
- The Phoenix Universe
- Theoretical Studies of Magnetic Monopole
- Time in Quantum Mechanics
- Weak Measurements
Entry Requirements

- 1st class BSc or MSci in Physics (or Maths)
  - Lagrangian and Hamiltonian mechanics
  - Quantum mechanics, Dirac notation
  - Special relativity, tensors
  - Electrodynamics

- Language Test
  - Needed for registration, not application!
  - See website for details
Fees and Funding

- Tuition fee (2014-15):
  - £7500 home/EU students
  - £23500 overseas
  - Part time half of this per year

- Scholarships: Check [website](http://website)!  
  - Imperial College Master’s Support Scheme
  - Santander Masters Scholarships
  - Other schemes for specific nationalities:
    - Imperial Postgraduate Prospectus
    - British Council
    - Your own country
Applications

- Online application system:
  - See link on the course website [http://www.imperial.ac.uk/theoreticalphysics/msc](http://www.imperial.ac.uk/theoreticalphysics/msc)
  - CV, personal statement, transcript of UG degree, two references

- Timescale:
  - Applications are processed as they arrive
  - Deadline end of July, but don’t leave it so late!
  - Outcome usually within 6 weeks

- Remarks:
  - Enter courses in order of preference
  - College only makes one offer
More Details

• Website: http://www.imperial.ac.uk/theoreticalphysics/msc

• Email: qfff@imperial.ac.uk

• Twitter: Follow @MScQFFF

• In person: Prof Arttu Rajantie, H605