

Patrick Dunne

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Research Experience

2016-present **Postdoctoral Research Associate**, *Imperial College*

- Some work

2012-2016 **PhD Student**, *Imperial College*

- Carried out searches for invisibly decaying Higgs bosons with the CMS detector focussing on the most powerful VBF production channel
- Led the combination of all CMS direct searches for invisible Higgs boson decays:
 - Carried out the statistical combination of the searches, studies of correlations between channels and set limits on the Higgs boson invisible branching fraction
 - Made public in CMS physics analysis summary HIG-15-012
- Led the search for invisibly decaying Higgs bosons in the VBF channel using parked CMS data from LHC run I
 - Responsible for trigger efficiency measurements, background estimation, systematic uncertainty studies and the setting of limits on the Higgs boson invisible branching fraction
 - Made public in CMS physics analysis summary HIG-14-038
- One of the lead analysers in the search for invisibly decaying Higgs bosons in the VBF channel using prompt CMS data from LHC run I
 - Performed background estimation and systematic uncertainty studies and set limits on the Higgs boson invisible branching fraction
 - Led the combination of this result with CMS searches in other channels, performing studies of correlations between the channels and limit setting
 - Made public in a paper selected for the cover of the European Physics Journal C and CMS physics analysis summary HIG-13-013
- Currently interpreting the results of these searches as limits on Higgs portal, two Higgs doublet and effective field theory dark matter models and studying data from LHC run II
- Co-founded a student seminar club to improve the presentation skills of students and inform the group of our research activities

2013 **Long Term Attachment**, *CERN*

- Based at CERN for four months as part of my PhD research
- Carried out detector operations shifts on the CMS detector

2012 **Masters Project**, *University of Oxford*

- Investigated the ‘Qjets’ algorithm for stochastic jet clustering as part of the ATLAS collaboration
- Identified improvements in the resolution of objects within jets with high transverse momentum

- 2005-2011 **Summer Projects, LLNL, Oxford, CERN, MIT**
- 2011 - Lawrence Livermore National Laboratory (LLNL), California: Performed studies of metals at high pressure using the Jupiter Laser Facility
 - 2010 - University of Oxford: Analysed data from the CDF experiment searching for non-standard model couplings in VBF produced W bosons
 - 2007 - CERN: Assisted in assembling a frequency scanning interferometry system for monitoring of the ATLAS semiconductor tracker
 - 2005 - MIT: Studied algorithms for robot control in the rapid prototyping group

Education

- 2012-2016 **PhD High Energy Physics, Imperial College**
- 2008-2012 **MPhys Physics, University of Oxford**, First class honours degree
- 2005-2008 **5 A levels, 12 GCSEs (2 short course), Sutton Grammar School**
- Grade A in physics, maths, further maths, electronics and chemistry A levels
 - Advanced extension awards in physics (distinction) and maths (merit)

Academic Awards

- 2014 **Poster Prize, Imperial College Physics Department**
- Prize at the postgraduate summer research symposium
- 2014 **Poster Prize, Imperial College Graduate School**
- Won second prize in the college wide graduate school poster competition
- 2013 **Poster Prize, STFC**
- Awarded for STFC high energy physics summer school poster competition
- 2012 **Peter Fisher Prize, Trinity College Oxford**
- Prize awarded to the student in college with the best finals results in physics
- 2012 **Mitchell Scholarship for Outstanding Students, Trinity College Oxford**
- Scholarship awarded to allow promising students to undertake research projects
 - Funds won used to participate in studies of metals at very high pressures using the Jupiter Laser Facility at Lawrence Livermore National Laboratory
- 2010-2012 **Millard Scholarship, Trinity College Oxford**
- Awarded for continued excellent performance in examinations
- 2010 **Gibbs Prize for Public Speaking, University of Oxford Physics Department**
- Best talk in department-wide physics speaking competition with 170 entries
- 2010 **Examiners' Commendation, Oxford University Physics Department**
- Awarded for outstanding performance in second year practical course
- 2009 **Millard Exhibition, Trinity College Oxford**
- Awarded for performance in preliminary examinations
- 2008 **Neate Physics Prize, Sutton Grammar School**
- Awarded to best physics student in the school

Teaching Experience

- 2016-present **PhD Student Supervision, Imperial College**
- Edward Atkin (2018-present): Development and construction of a high pressure time projection chamber
 - Toby Nonnenmacher (2017-present): Development and construction of a high pressure time projection chamber
 - Artur Sztuc (2016-present): Neutrino oscillation analyses on the T2K experiment
- 2014-present **Masters Student Supervision, Imperial College**
- Supervised five students undertaking simulation and hardware projects on high pressure time projection chambers for detecting neutrino interactions
 - Supervised five students undertaking projects on searches for VBF produced invisible Higgs boson decays and their interpretations
- 2017-present **Lecturer on PhD course on neutrino physics, Imperial College**
- 2016-present **Third Year Tutorials, Imperial College**
- Responsible for teaching 6 classes of 4 students for the comprehensive exams which are on all material covered in the first two years
- 2013-2016 **Undergraduate Lab Demonstration, Imperial College**
- Demonstrated in second year radioactivity lab
 - Voted best lab demonstrator by students in AC 2013/14 and 2014/15
 - Responsible for interviewing students and marking their work

--- Outreach

- 2018 **Gave lecture on neutrino oscillations at the High Energy Physics Masterclass, Imperial College, London**
- 2017 **Assisted at the High Energy Physics Masterclass, Imperial College, London**
- 2017 **Ran high energy physics stand at careers fair, Coombe Boys' School**
- 2016 **Ran high energy physics stand at the Big Bang Fair, Sutton Grammar School**
- 2016 **Assisted at the High Energy Physics Masterclass, Imperial College, London**
- 2015 **Gave talk on Searching for the Higgs boson at the LHC, Sutton Grammar School**
- 2014 **Assisted at the Royal Society Summer Exhibition, London**
- 2014 **Assisted at the High Energy Physics Masterclass, Imperial College, London**
- 2013 **Tour Guide, CMS detector, CERN**
- 2013 **Assisted at the Bang Fair, ExCel Centre, London**
- 2013 **Assisted at the High Energy Physics Masterclass, Imperial College, London**

--- Memberships and Collaborations

- 2017-present **HPTPC Collaboration**
- 2016-present **T2K Collaboration**
- 2012-2016 **CMS Collaboration**
- 2008-present **Institute of Physics**
- 2012 **ATLAS Collaboration**

Talks

- 2015 **CMS Higgs Group**, *Approval and pre-approval talks for analysis HIG-15-012*, ‘A combination of searches for the invisible decays of the Higgs boson using the CMS detector’
- 2015 **IOP HEP Group Conference, Manchester**, ‘Searches for invisible decays of the Higgs boson with the CMS detector’
- 2015 **CMS UK Collaboration Meeting**, ‘VBF Higgs to Invisible - Towards Run II’
- 2014 **CMS Higgs Group**, *Pre-approval talk for analysis HIG-14-038*, ‘Search for invisible decays of Higgs bosons in the vector boson fusion production mode’
- 2014 **PANIC Conference, Hamburg**, ‘Searches for invisible decay modes of the Higgs boson with the CMS detector’
- 2014 **CMS Higgs Group**, *Approval talk for analysis HIG-13-030*, ‘Search for invisible decays of Higgs bosons in the vector boson fusion and associated ZH production modes’
- 2014 **CMS UK Collaboration Meeting**, ‘Higgs to invisible analyses at CMS’

Seminars

- 2017 **Imperial College, London**, Latest neutrino oscillation results from the T2K experiment
- 2017 **University of Bristol**, Latest neutrino oscillation results from the T2K experiment
- 2016 **Royal Holloway University of London**, Higgs to invisible analyses at CMS

Publications

Co-author on 154 citable papers as part of the CMS collaboration (inSPIRE HEP, January 2016) and have an h_{hep} index of 34. Selected papers with substantial contributions are given below:

- 2015 **CMS Collaboration**, ‘*A combination of searches for the invisible decays of the Higgs boson using the CMS detector*’, CMS Physics Analysis Summary - HIG-15-012
 - Was the main analysis contact for the CMS review process
 - Led the analysis and performed the statistical combination of the separate searches, studies of correlations between channels and limit setting
- 2015 **CMS Collaboration**, ‘*Search for invisible decays of Higgs bosons in the vector boson fusion production mode*’, CMS Physics Analysis Summary - HIG-14-038
 - Was the main analysis contact for the CMS review process
 - Led the analysis and was responsible for trigger efficiency measurement, background estimation, systematic uncertainty studies and setting limits on the Higgs boson invisible branching fraction
- 2014 **CMS Collaboration**, ‘*Search for invisible decays of Higgs bosons in the vector boson fusion and associated ZH production modes*’, Eur. Phys. J. C 74 (2014) 2980
 - One of the lead analysers responsible for background estimation, systematic uncertainty studies and the setting of limits on the Higgs boson invisible branching fraction in the most powerful VBF channel
 - Led the statistical combination of the separate searches and studies of correlations between channels
 - This paper has received 134 citations (inSPIRE HEP, January 2016)

- 2013 **CMS Collaboration**, ‘*Search for invisible decays of Higgs bosons in the VBF channel*’, CMS Physics Analysis Summary - HIG-13-013
- One of the lead analysers responsible for background estimation and systematic uncertainty studies
 - First limit on the Higgs boson’s invisible branching fraction in the most sensitive VBF channel

Further Information

Computing

- Experienced in C++, C, python and the ROOT analysis framework
- Have administered mysql and html servers on linux computers
- Use the MadGraph and Delphes packages for Monte Carlo event generation and detector simulation

Languages

- English (native), French and German (limited working proficiency)

Positions of Responsibility

- 2018-present Seminar organiser for Imperial College high energy physics group
- 2017-2018 T2K Young representative for Europe
- 2018-present Fire warden for High Energy Physics group at Imperial College
- 2014-2016 Member of Imperial College high energy physics student seminar organising committee
- 2010-2013 Youth representative to national council of the Scout Association
- 2010-2012 Returning officer and webmaster for Trinity College Junior and Middle Common Rooms

References