

Patrick Dunne

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Research Experience

- 2012-present **PhD Student**, *Imperial College*, Expect to submit early in 2016.
- 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 detector
 - 2005 - MIT: Studied algorithms for robot control in the rapid prototyping group

Education

- 2008-2012 **MPhys Physics**, *University of Oxford*, First class honours degree.
- 2005-2008 **5 A levels, 11 GCSEs**, *Sutton Grammar School*.
- A grades 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

Teaching Experience

- 2014-present **Masters Student Supervision**, *Imperial College*.
- Supervised/supervising seven students undertaking projects on searches for VBF produced invisible Higgs boson decays and their interpretations

- 2013-present **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

- 2015 **Searching for the Higgs boson at the LHC, Sutton Grammar School.**
- 2014 **Royal Society Summer Exhibition, London.**
- 2014 **High Energy Physics Masterclass, Imperial College, London.**
- 2013 **Tour Guide, CMS detector, CERN.**
- 2013 **Bang Fair, ExCel Centre, London.**
- 2013 **High Energy Physics Masterclass, Imperial College, London.**

Memberships and Collaborations

- 2012-present **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.**

Publications

Co-author on 134 publications as part of the CMS collaboration (inSPIRE HEP, October 2015) and have an h_{hep} index of 29. 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
 - Lead analyser of the statistical combination of the separate searches and studies of correlations between channels

- 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
 - Lead analyser 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
 - Lead analyser of the statistical combination of the separate searches and studies of correlations between channels
- 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
- Use the MagGraph and Delphes packages for Monte Carlo event generation and detector simulation

Languages.

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

Positions of Responsibility.

- 2014-present 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

Dr. David Colling, *Reader in high energy physics*, Imperial College, d.colling@imperial.ac.uk.

Second referee to be asked!!.

Third referee to be asked!!.