

Patrick Dunne

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Statement

I'm pleased to have been nominated to stand for the Spokespersons Advisory Committee. I have led the T2K oscillation analysis group for the last 4 years and am one of the conveners of the T2K+NOvA joint fit so I know what it takes to deliver successful precision oscillation measurements. This experience also means I know what must be improved to realise DUNE's ambition to make precision measurements of all our oscillation parameters of interest in one experiment without degeneracy.

I am excited to support the collaboration and spokespeople in shaping our technical and analysis program to achieve this ambition. Particularly important in this is the phase 2 program, and I believe the SAC needs strong expertise in this area. I am the spokesperson of the ND-GAr test beam program and have been involved in the gaseous-argon TPC research program for the last 5 years, so combined with my oscillation analysis expertise I feel I would be able to fulfil this requirement.

As well as providing expertise, the SAC must also communicate the views of the wider collaboration to the spokespeople. I am UK-based and well connected to the wider European DUNE community, so I can help the spokespeople to understand the needs of European collaborators. Furthermore, navigating large international collaborations isn't easy wherever you're from, particularly for early career members of the collaboration. As a former T2K-young representative with experience of working in very large international groups through my PhD on CMS I will make sure collaborators have an effective channel to get information to the spokespeople. Finally, I am keen to take the opportunity that the SAC provides to make the environment that we work in as open and inclusive as possible.

Academic Positions

- 2021-present **UKRI Future Leaders Fellow**, Imperial College (£1.5M over 4 years)
- 2016-2021 **Postdoctoral Research Associate**, Imperial College
- 2018-present **Visiting Academic**, Royal Holloway University of London
- 2012-2016 **PhD Student**, Imperial College (including Long Term Attachment at CERN)

Research Leadership Positions

- 2018-present **Convenor of T2K Oscillation Analysis Group** (30+ members, 7 countries)
- 2016-present **Leader of MaCh3 Bayesian Analysis Group** (20 members, 4 countries)
- 2022-present **T2K+NOvA joint analysis interexperiment liaison**
- 2019-present **Spokesperson** for FNAL beam test of HPgTPC
- 2022-present **DUNE Near Detector Data Acquisition (DAQ) Integration Coordinator**
- 2019-2022 **T2K+NOvA joint analysis fitting group coordinator**
- 2021-2022 **Convenor of DUNE Near Detector Upstream DAQ Group**
- 2017-present **UK HPgTPC DAQ Coordinator**
- 2018 **UK HPgTPC Run Coordinator** for beam tests

Education

- 2012-2016 **PhD** (High Energy Physics) Imperial College (viva in May 2016)
Thesis: Searches for invisibly decaying Higgs bosons with the CMS detector
- 2008-2012 **MPhys** (Physics) University of Oxford, First Class Honours
- 2005-2008 **5 A levels at grade A, 2 Advanced Extension Awards, 12 GCSEs**, Sutton Grammar School

Academic Awards

- 2014 **Poster Prize**, Imperial College Graduate School Poster Competition
- 2014 **Poster Prize**, Imperial College Physics Department Research Symposium
- 2013 **Poster Prize**, STFC High Energy Physics Summer School
- 2012 **Peter Fisher Prize** for best finals results in physics, Trinity College Oxford
- 2011 **Mitchell Scholarship for Outstanding Students**, Trinity College Oxford
- 2010 **Gibbs Prize for Public Speaking**, University of Oxford Physics Dept.
- 2010-2012 **Millard Scholarship** for continued excellent exam results, Trinity College Oxford
- 2010 **Examiners' Commendation** for outstanding practical course results, Oxford Physics
- 2009 **Millard Exhibition** for excellent preliminary exam results, Trinity College Oxford
- 2008 **Neate Physics Prize** for best physics student in the school, Sutton Grammar School

Research Experience

Leading T2K's analysis of neutrino oscillations

- **Convenor of the Oscillation Analysis working group** (30+ members) responsible for delivering T2K's flagship neutrino oscillation analysis
- **Lead the MaCh3 analysis group** (20 members) which uses Bayesian Markov chain Monte Carlo techniques to analyse T2K data from the near and far detector simultaneously
- **Lead analyser for first exclusion of the CP conserving values of δ_{CP} at 95% confidence level**, published in **Physical Review Letters** as an **editor's suggestion**.
- **Lead analyser for the first exclusion of values of δ_{CP} at 3σ , published on cover of Nature**

Expanding the MaCh3 analysis to joint T2K-NOvA analyses, and future experiments

- **T2K+NOvA analysis inter-experiment liaison** responsible for delivering T2K+NOvA joint analysis and negotiations between T2K and NOvA collaborations. This position has previously only been held by former analysis co-ordinators of T2K and NOvA.
- Working towards first joint analysis of long-baseline experiments with full systematics
- **Leading team producing first Bayesian oscillation analysis for DUNE**
 - MaCh3 is licensed as a public software package to facilitate this

Designing DUNE's near detector

- Designing and testing an HPgTPC for the ND-GAr component of DUNE's near detector
 - Developing electronics for this detector with FNAL and Pittsburgh
 - **Spokesperson for a Fermilab beam test of this detector's wire chambers**
- **DUNE near detector data acquisition integration coordinator**

Developed a High-Pressure gas Time Projection Chamber (HPgTPC) prototype

- Leading member of a UK collaboration which has constructed the world's largest electroluminescence HPgTPC and tested it in a beam at CERN in 2018
- Responsible for construction and running of the experiment's data acquisition (DAQ) and slow control systems, led the construction of the detector at Royal Holloway
- Run coordinator during (dis)assembly and 24/7 operation of the detector at CERN
- Responsible for detector arrival and departure logistics and transport at CERN

Searched for decays of Higgs Bosons to invisible final states (2012-2016)

- Led the first combination of all CMS direct searches for invisible Higgs boson decays: Published in European Physics Journal C as the cover of the journal

Masters and Summer Projects (2005-2012)

- Lawrence Livermore National Laboratory, Oxford, MIT, CERN

Supervision and outreach

- 2021-present **Line manager** to two post doctoral researchers at Imperial
- 2016-present **PhD Student Supervision** main supervisor to two Imperial PhD students and assistant supervisor to two other students who have graduated
- 2014-present **Masters and Bachelors Student Supervision** 15 students supervised to completion
- 2013-present Involved in over 20 outreach events with a particular focus on highlighting neurodiverse individuals in science

Publications

I am an author on 363 citeable papers (24 as a member of the T2K collaboration, 13 as a member of the DUNE collaboration) and 319 as a member of the CMS collaboration). Citations in inSPIRE HEP indicate an h-index of 104. A full list of publications is at: <http://inspirehep.net/search?p=exactauthor%3AP.Dunne.1>

A selected list is:

- “Constraint on the Matter-Antimatter Symmetry-Violating Phase in Neutrino Oscillations”, Nature 580 (2020) 7803, 339-344. [331 citations, journal impact factor 54.6], published on the cover of the journal.
- “Search for CP Violation in Neutrino and Antineutrino Oscillations by the T2K Experiment with 2.2×10^{21} Protons on Target”, Phys. Rev. Lett. 121 (2018) no.17, 171802. [214 citations, journal impact factor 7.5].
- “Measurement of neutrino and antineutrino oscillations by the T2K experiment including a new additional sample of ν_e interactions at the far detector”, Phys. Rev. D 96 (2017) no.9, 092006. [197 citations, journal impact factor 4.4].
- “T2K measurements of muon neutrino and antineutrino disappearance using 3.13×10^{21} protons on target”, Phys. Rev. D 103 (2021) no.1, 011101. [7 citations, journal impact factor 4.4].
- “Search for Electron Antineutrino Appearance in a Long-baseline Muon Antineutrino Beam” Phys. Rev. Lett. 124 (2020) no. 16, 161802. [10 citations, journal impact factor 7.5].
- “Commissioning of a High-Pressure Time Projection Chamber with Optical Readout”, Instruments 2021, 5(2) 22, selected for the cover of this issue of Instruments.
- “Search for invisible decays of Higgs bosons in the vector boson fusion and associated ZH production modes”, Eur. Phys. J. C74 (2014) 2980. [250 citations, journal impact factor 4.8]. This publication was selected for the cover of this edition of EPJC.
- “Vector Boson Fusion Searches for Dark Matter at the LHC”, Phys. Rev. D 93 (2016) no.11 113013. [18 citations, journal impact factor 4.4].
- “Searches for invisible decays of the Higgs boson in pp collisions at $\sqrt{s} = 7, 8, \text{ and } 13 \text{ TeV}$ ”, J. High Energ. Phys. (2017) 135. [175 citations, journal impact factor 5.8].

Talks

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| 2020 | ICHEP 2020 , Virtual, ‘Status of the DUNE Near Detector’ |
| 2020 | Neutrino 2020 , Virtual, ‘Latest Neutrino Oscillation Results from T2K’, Invited Plenary Talk , First non-faculty member to present new T2K oscillation results |
| 2019 | T2K-NOvA Workshop , Fermilab, ‘Challenges in and a work plan for the joint fitting approach’ |
| 2019 | FPCP 2019 Conference , Victoria, ‘Long-baseline and atmospheric neutrino experiments’, Invited Plenary Review Talk |
| 2019 | T2K-NOvA Workshop , Fermilab, ‘T2K Systematic Uncertainty Impact Studies’ |
| 2018 | Nu-print Workshop , Fermilab, ‘Critical cross-section modeling issues for the oscillation program’, Invited Plenary Review Talk |
| 2017 | T2K-NOvA Workshop , Tokai, ‘T2K Oscillation Analysis Summary’ |
| 2017 | NuFACT 2017 Conference , Uppsala, ‘Oscillation results and plans from the T2K experiment’ |
| 2016 | DMLHC Conference , Amsterdam, ‘Latest results on invisibly decaying Higgs bosons’ |
| 2015 | IOP HEP Group Conference , Manchester, ‘Searches for invisible decays of the Higgs boson with the CMS detector’ |
| 2014 | PANIC Conference , Hamburg, ‘Searches for invisible decay modes of the Higgs boson with the CMS detector’ |
| 2014-2015 | CMS Higgs Group , ‘4 result pre-approval and approval talks’ |