Mark Thomson

Career History

2008 – : Professor of Experimental Particle Physics, University of Cambridge.
2004 – 2008: Reader in Experimental Particle Physics, University of Cambridge.
2000 – 2004: University Lecturer (Physics), University of Cambridge.
1996 – 2000: CERN Staff Research Physicist, CERN.
1994 – 1996: CERN Fellow, CERN.
1992 – 1994: Research Fellow, University College London.
1988 – 1991: D. Phil. in Experimental Astroparticle Physics (Soudan 2), University of Oxford.
1985 – 1988: B. A. Physics, University of Oxford.

Career Summary

My research career has focused on neutrino physics, electroweak physics at electron-positron colliders, calorimetry and the development of advanced analysis/reconstruction techniques. My current research focus is on LBNF and the Fermilab SBN programme (MicroBooNE and LAr1-ND). Previously I worked on oscillation physics with the MINOS experiment (ν_μ disappearance, ν_e appearance and atmospheric neutrinos) and the OPAL experiment at the Large-Electron-Positron (LEP) collider at CERN, where I led several of the key measurements of the properties of the W and Z bosons. I have a strong interest in calorimetric techniques for particle physics and I am one of the pioneers of Particle Flow Calorimetry that lies at heart of many concepts for future collider detectors. I am passionate about the teaching of physics and recently published my first book "Modern Particle Physics".

Research Management

I have held a number of positions of responsibility, the most significant are listed below:

2014 – 2015: Member of the LBNF Interim Executive Board.
2014 – : LBNF-UK Principal Investigator.
2013 – 2015: Elected member of the LBNE Executive Board.
2013 – 2015: Member of the Linear Collider Collaboration (Physics & Detector) Executive Board.
2011 – 2015: Work Package Manager and budget holder for the UK ATLAS L1 Calorimeter Upgrade.
2006 – 2008: Chair of MINOS Publications Committee.
2004 – 2010: Elected member of the MINOS Executive Board.
1997 – 2000: Member of the LEP W-Physics Steering Board.
1996 – 2010: Member of the LEP Electroweak Working Group.
1995 – 1999: Convenor of the OPAL W-Physics Working Group.

I have convened a significant number of other working groups and have been on the organising committees for numerous workshops and international conferences.

Peer Review and Project Oversight

I have held positions of responsibility in the UK funding agency (STFC) review and advisory structure, including charing the STFC Project Peer Review Panel (PPRP). This is the primary peer review panel of STFC, assessing all project proposals (large and small) for particle physics, astrophysics, astroparticle physics and nuclear physics. For the last six years, I have been a member of the UK Particle Physics Advisory Panel (PPAP), which advises STFC on the strategic direction for its particle physics programme and is responsible for maintaining the long-term UK roadmap for the field.

2014 : Member of DOE Review of MAP/MICE.
2013 : Chair of STFC Review of Future Multi-Object Spectrographs.
2012 – : Chair of the STFC MICE Oversight Committee.
2012 : Chair of STFC Review of the UK HIPER project for inertial contained nuclear fusion.
2011 – 2015: Member of the Royal Society URF Selection Panel.
2011 – 2013: Chair of the STFC Project Peer Review Panel (PPRP).
2009 – 2011: Deputy Chair of the STFC PPRP.
2008 – 2014: Member of the UK Particle Physics Advisory Panel (PPAP).

University, Teaching and Mentoring Roles

I am deeply committed to the teaching of physics and have held positions of responsibility within the Cambridge physics department (the Cavendish Laboratory) and Cambridge University. I have been the Director of the UK HEP graduate summer school, an annual two-week residential course attended by all UK first-year experimental particle physics graduate students. My teaching-related roles include:

2011 : Member of the Faculty Board and Degree Committee for Physics and Chemistry.
2010 – 2013: Director of the UK HEP graduate summer school.
2010 – 2013: Chair of the Cavendish Consultative Committee.
2006 – 2008: Member of the Cavendish Executive Board.
2004 – 2006: Member of the Cavendish Teaching Committee.
2002 – : Director of Studies for the Physical Natural Sciences at Emmanuel College, Cambridge.

The mentoring of undergraduates, graduate students and post-doctoral researchers is a responsibility that I take very seriously. At Emmanuel College I am responsible for the academic well-being of about fifty undergraduates, providing academic and career advice (and writing many reference letters). My success in this role, as measured by academic performance and the large numbers progressing to graduate-level study (many in particle physics) has made Emmanuel one of the top Cambridge colleges for physics.

Books

Modern Particle Physics, M.A. Thomson (2013): published by Cambridge University Press, ISBN: 978-1107034266. This advanced undergraduate level textbook grew out of my Cambridge Part III "Particle Physics" major option course. It has been widely adopted in the UK and elsewhere.

Research Highlights

LBNF and Fermilab SBN programme: LBNF and the SBN neutrino programme represent the most exciting medium- and long-term scientific opportunities in our field. In addition to oscillation physics, I am particularly interested in pattern recognition challenges and opportunities for calorimetric measurements in LAr-TPCs. In Cambridge we are making rapid progress with developing fully-automated LAr-TPC reconstruction software that is applicable to MicroBooNE and LBNF (and any other LAr-TPC).

MINOS: I contributed to many of the main MINOS neutrino oscillation analyses, either individually or as leader of the Cambridge MINOS group, including: atmospheric neutrinos [Phys. Rev. D73 (2006) 072002 and Phys. Rev D86 (2012) 052007]; ν_e appearance [Phys. Rev. Lett. 107 (2011) 071103]; and ν_μ disappearance [Phys. Rev. Lett. 97 (2006) 191801]. For the ν_e appearance analysis, I was the originator of the Library Event Matching (LEM) technique used by MINOS and now adapted for NOνA. I was the originator of the Bayesian analysis technique used in the MINOS atmospheric neutrino and ν_μ disappearance analyses [NIM A707 (2013) 127–134].

Particle Flow Calorimetry: I am one of the world-leading experts in high-granularity Particle Flow (PFlow) Calorimetry. With the development of the PandoraPFA reconstruction, I provided the first (and still only) proof-of-principle that high-granularity PFlow calorimetry can deliver large performance gains over traditional collider detector calorimetry [NIM A611 (2009) 25–40]. PFlow calorimetry is now the baseline for all future linear collider detector concepts and is the one of the two options for the CMS calorimeter upgrade. The Pandora framework also forms the basis for my recent work on LAr-TPC reconstruction.

The OPAL experiment at LEP: I played leading roles (either as the main analyser or coordinating the analysis) in several key electroweak measurements. At the Z resonance I measured the tau polarisation [Z. Phys. C72 (1996) 556–560] using a novel application of the Maximum Entropy image enhancement technique [NIM A382 (1996) 553–560] and the leptonic Z line shape (tau pair cross sections) and forward-backward asymmetries [Eur. Phys. J19 (2001) 587–651]. I made several major contributions to the study of the W-boson, leading the OPAL W-physics working group and made major personal contributions to the W-boson mass [Phys. Lett. B507 (2001) 29–46] and WW production cross section/W branching ratio measurements [Eur. Phys. J. C52 (2007) 767–785]. I pioneered the first experimental study of possible anomalous quartic gauge boson couplings [Phys. Lett. B471 (1999) 293–307].