Institution: University of Sussex

Unit of Assessment: UoA 9 Physics

OVERVIEW

The Department of Physics and Astronomy (P&A) is one of two departments within the School of Mathematical and Physical Sciences (MPS). Members of P&A are being returned within a single unit of assessment (UoA 9 Physics). The Department is structured into 4 research groups whose principal interests are as follows:

- Astronomy (Astro): extragalactic surveys; structure formation; cosmology
- Atomic, molecular and optical (AMO): ion traps; quantum information processing; quantum electrodynamics
- Experimental Particle Physics (EPP): accelerator physics (CERN/ATLAS); neutrino physics (NOvA/MINOS+); neutron electric dipole moment (CryoEDM)
- Theoretical Particle Physics (TPP): collider and low-energy phenomenology; particle astrophysics and cosmology; non-perturbative quantum field theory and quantum gravity

Over the last 5 years, we have executed a significant, strategic growth plan enabled by a major investment by the University and HEFCE (totalling ~£10M) into P&A, nearly doubling the faculty base from 20 to 38. All 38 are research active at an internationally competitive level but, for REF2014, we have chosen to present the outputs from 24.75 FTE to exhibit the most 'excellent' research this broader base allows us.

This rapid expansion should be borne in mind when interpreting our student-number and research-income statistics, which will lag. Nevertheless, our Research Council and EU funding have increased significantly since 2008 and the number of registered research students has more than doubled.

We have thus completed a transition from a small to a middle-sized department while enhancing our quality and now have a strong and sustainable basis from which to achieve our ambition of becoming a large UK department with a world-leading reputation.

RESEARCH STRATEGY

Our vision for P&A is to undertake extremely high-quality research focused on a limited number of areas. With this strategy we aim to achieve a critical mass of activity of the highest quality to enable us to be world-leading. Our driving strategy is thus for controlled growth and we specifically:

- build upon the excellent foundations of our existing research groupings by expanding faculty numbers to attain world-leading status in each of our specialist areas;
- develop our research groups by expanding their footprint into closely related areas;
- nucleate, with critical mass and expanded footprint, a new experimental activity with a view to expanding our potential for socio-economic impact (beyond REF2014); and
- build in a sustainable way with a long-term aim of attaining a faculty-base of about 50 research-active staff.

With this strategy we aim, over a period of 10 years, to become one of the top ten physics departments in the UK, both in terms of quantity and of quality. P&A has a world-leading research profile (reaching 37th in the world according to the *Times Higher Education World University Rankings* 2010; highest citations per paper in both *Physics* and *Space Sciences* in the most recent Thomson Reuters analysis), and achieved an average quality of 2.7 in RAE2008, placing us 12th equal in the UK. In terms of size, however, we were only 32nd out of 42 UK physics departments in 2008. In that 2008 table, our current faculty numbers would place us 16th, and our planned extension to 50 research-active faculty would take us into the top 10.

Our strategy of focused expansion on areas of strength is enhanced by collaboration to add breadth. Thus, in 2008, Sussex was a founding member of the South-East Physics Network (SEPNet: Kent, Queen Mary, Royal Holloway, Southampton, Surrey and Sussex; also Portsmouth and Oxford as

associate partners) whose aim was 'to create a consortium to advance and protect Physics as a strategically important subject for the UK economy and its science base, collaboratively securing its disciplinary and financial sustainability in the South East Region' and to 'create a subject collaboration in teaching, research and outreach'. It has been extremely successful in each of these respects and the initial 5-year arrangement has been expanded for a second term (SEPnet-2), including more departments and a broader scope with the development of a regional PGR Graduate School, and enhanced efforts on diversity and socio-economic impact. SEPnet provided an impetus for our growth but continues to influence our strategy in a regional context.

The research groups adopt the departmental strategy at a smaller scale, i.e. focused, controlled growth, built from and between peaks of existing excellence.

Astro – Our scientific objectives in astronomy are tightly focused on cosmology and galaxy evolution, tackled with a broad theoretical, numerical and observational expertise base and with particular speciality in statistical studies of surveys. Our expansion strategy has been to strengthen the expertise while maintaining our scientific focus. We have increased our faculty numbers from 7 to 12, slightly expanding our footprint and linking together the existing work – e.g. between numerical simulations and observational surveys. We have secured strong involvement with major projects – e.g. Planck, Herschel, DES, LOFAR and Euclid – and are well-positioned to exploit facilities such as ALMA and JWST. We have consolidated our position as one of the leading extra-galactic astrophysics groups in the UK.

AMO – The aim is to establish a world-leading centre for Quantum Technology and develop related activities which open up opportunities for socio-economic impact and provide an environment conducive to the future establishment of a new, experimental research group. We have increased the faculty from 5 to 9 members. The group now contains a high-profile centre for charged particle trapping (atomic and molecular ions, electrons) with applications to quantum information-processing, quantum simulation, improved mass spectroscopy, and high-precision measurements. This has been enhanced with new, experimental appointments and a greater synergy with theoretical activity through strategic appointments. New experimental activity in ultrafast optical processes and THz science develops opportunities for economically-relevant technology.

EPP – The theme for our experimental particle physics is exploring the boundaries where new physics might be found. We have well-established leadership in niche aspects of precision measurements of the properties of neutrons and neutrinos. This secure base and a strategic regional context for collider physics provided by NeXT in SEPnet, with allied expansion in our TPP group, has enabled the establishment of a flourishing new ATLAS team, led by De Santo, with world-leading expertise in the search for new physics (especially supersymmetry) at the Large Hadron Collider (LHC). These investments have increased faculty numbers from 5 to 9.

TPP – The group has expanded its portfolio towards particle phenomenology, with faculty numbers increasing from 3 to 8. It provides leadership in its core science areas, including fundamental particle physics, quantum gravity, low-energy and collider phenomenolgy, particle cosmology and their interfaces. The group is actively involved in physics searches at the LHC, for dark matter, and exploiting cosmological data to determine the boundaries of the standard models of particle physics and cosmology. The group is founding member of the regional NExT Institute under SEPnet, presently chaired by Litim, offering novel synergies between theory and experiment, in particular with EPP and regional partners. Since 2011, the group maintains an STFC-funded TPP research consortium with RHUL. Further successes include Jaeger gaining the sole STFC SPG postdoctoral grant UK-wide in 2009, and Calmet leading the quantum black-hole section of the EU-funded COST action 'Black holes in a violent universe'.

PEOPLE

Staffing strategy and staff development

Our controlled growth strategy is reflected in our staff recruitment and development. In general our expansions are into areas close to our existing strengths. This means that we have the expertise to be able to identify excellent researchers at early stages in their careers. Our reputation in their

fields is also sufficiently high for us to be able to attract and retain the best researchers. We then provide the support to allow them to develop and become leading researchers in their own right. Recruitment potential is enhanced by the University policy to transfer researchers on 5-year personal fellowships to permanent contracts, and a recent example is the appointment of Byrnes (Royal Society URF).

The University provides the full range of training and staff-development courses that a research-intensive University requires to develop its staff, including regular briefing and training sessions for research staff on applying for research funding. We enhance this at the School and departmental levels to ensure that new staff are fully supported in developing their research potential.

Within each research group in P&A, there is a range of experience from faculty appointed in the late 1980s to the present day. Leadership is provided by the professorial staff within each research group and by the Director of Research and Knowledge Exchange (DoRKE) who chairs the Department's Research Strategy Group (RSG). Faculty of Reader status often represent research groups on the RSG and so gain leadership experience.

We provide generous start-up packages, including PhD students for all new appointments, and teaching remission. Interactions and peer support within the research groups are naturally strong so new research staff are appointed a mentor from outside their immediate research group, to share best practice.

We have a formal pre-submission peer-review system for research grants, operated by the DoRKE and the Head of School. We have also initiated a post-outcome review in which applicants are required to make a forward plan of action following an unsuccessful outcome. This has proved very effective, with *all* our faculty obtaining research grant funding before the end of their probationary periods. The success of this staff-development strategy at various stages is evidenced by a remarkable award of 2 ERC Starting Grants in 2012 (Hartnell, Seery, by far the highest success rate *per capita* in the country), significant awards to developing faculty (e.g. Hensinger – EPSRC Leadership), and 6 of our 7 professors being internal promotions (with the 7th appointed as Head of School).

Diversity

The strategy of growth of excellent research requires the largest talent pool. The Department thus seeks to recruit, support and retain the highest-quality researchers from the top institutions around the world, from all backgrounds and of either gender. The Department, with the University and SEPnet-2, is thus making a strategic commitment to increase the diversity of our staff at all levels. At postdoctoral level, about a quarter of our appointments are from outside the UK but, for faculty appointments, this becomes an overwhelming majority. Of the 38 Category A faculty, 16 have UK nationality, and most of the other 22 are from the EU. This policy has allowed us to attract world-leading research activity to Sussex – for example, the Ion-trap group within AMO, and the ATLAS group within EPP. Currently, 2 of our 4 research-group leaders are from outside the UK.

The University of Sussex has recently received the bronze award from the Athena SWAN Charter for its commitment to improving employment practices in recruiting and promoting women to senior positions in STEM departments. The Department is a supporter of Project Juno, the IoP scheme to support women in physics and encourage better practice for both genders. The Department will be applying for Athena SWAN bronze in April 2014 and then to upgrade our Juno status. We have allocated funds for a part-time Equality and Diversity Coordinator for the Department, and we are supported by the SEPnet Diversity Director (Prof. A. MacDonald). The University's flexible working policy and procedures allow working parents to request flexible working patterns to enable them to balance their home and work responsibilities. A number of both female and male academics in the SET departments have been granted flexibility in their teaching timetables so that they are able to meet their childcare commitments. All formal meetings and committees of the Department and University are scheduled to take place within core working hours. The University's maternity, paternity and adoption leave schemes offer significant enhancements over the statutory schemes. The University's childcare facilities have been rated by Ofsted as 'excellent'. This provision is to be significantly expanded, with a £2M new building which is due to open in January 2014.

To facilitate the progress of women into senior management, 3 of our female faculty have been given positions of significant responsibility within the Department (Romer, Deputy Head of Department; de Santo, Director of Graduate Studies) and School (Eberlein, Director of Teaching and Learning) and of our two professorial promotions this year, one was a woman.

Research students

We aim to attract the best students, regardless of background. Recruitment is undertaken separately within each research group, with oversight by the Director of Graduate Studies. Start-up funds are provided by the University to ensure that all new faculty have a PhD student and are paired up with an experienced second supervisor. The allocation of quota studentships to established supervisors is done as equitably as possible. Self-funded students have more of a free choice. MPS adopts a flexible approach to the use of School funds to support PGR studentships, including the provision of matched funds where appropriate to obtain maximum value from external sources of support. This enables the School to support roughly twice as many PGR students as would otherwise be possible and thus currently subsidises studentships to a value of around £200k p.a.

The University has established a Doctoral School which provides a clear focus of institutional responsibility for doctoral students and early-career researchers. The University has been awarded a European Commission HR Excellence in Research badge in recognition of its good practice in the career development of researchers. Research fellows are encouraged to undertake some or all of this training as part of their personal development. The Doctoral School runs a broad training programme for both postgraduate and postdoctoral researchers which maps onto the Vitae Researcher Development Framework. It also provides, amongst other things, a Research Staff Association, funding for researcher-led initiatives, and careers advice. To enhance this we have developed a plan for a graduate network with our SEPnet-2 consortium which will provide a regional, physics-focused training.

SEPnet has, over the past 5 years, provided PhD studentships for projects that are joint between SEPnet partner institutions. This has proved very successful in stimulating new joint research projects: e.g. collaboration between Sussex and Surrey on the production of next-generation ion chips for quantum technologies; and a collaborative project between Sussex, Surrey and RAL for the development of a Time-of-Flight Positron-Emission Tomography (TOF-PET) scanner. Collaborations are an important element in our regional strategy and will be increased in SEPnet2; the University is committed to providing at least 1 new student a year for this scheme.

Our recruitment strategies have resulted in a large expansion in PhD numbers over the last 5 years. In 2007 we had 25 registered PhD students; by 2012 that number had risen to 59. Our research strategy and that of the region depends on a good supply of high-quality research students. We thus extend our strategy for developing excellent researchers to UG and PGT levels. At Sussex we have a unique and highly successful UG Research Placement programme and a renowned MSc programme. We believe our UG training for PG research to be second-to-none: in the SET Student-of-the-Year awards, we have had 7 finalists, 3 physics winners and 2 overall winners since 2000.

We provide a full programme of induction and support. Continual training in research-specific topics happens through participation in one of the rich seminar programmes run by the different research groups in the Department, and through participation in national and international research meetings, summer-schools, workshops and conferences. Mentoring is provided by a close association of students and postdoctoral fellows within research groups and all students are allocated a second supervisor. Advanced courses are provided both locally and by SEPnet partners via dedicated video-conferencing facilities which will be enhanced in SEPnet-2.

Career development for research students is a priority and we have a faculty member with responsibility for PG careers. Students are also strongly encouraged to undertake formal employability and transferable-skills training through participation in focused events organised either by the University or externally, monitored in their annual appraisal. Since research careers are highly dependent on research papers, we have recently introduced the option of a ‘paper-style’

PhD in Astronomy in which students may submit a collection of their papers together with a literature review and overview. The first student to take this option, J. Frazer, has already started a postdoc position (UCL) with a second secured (University of Bilbao). A major component on the SEPnet-2 Graduate Network will be postgraduate employability-skills career development, through active engagement with national, local and regional employers.

INCOME, INFRASTRUCTURE AND FACILITIES

Our total research funding (actual spend) has increased steadily from £2.1M in 2008/09 to £3.2M in 2012/13. As of the end of September 2013, £2.8M had already been secured for 2013/14. The Physics and Astronomy Department has a mature record of grant-earning and has been active in pursuing all major funding avenues. The majority of our funding (65 per cent on open awards) comes from UK research councils, principally EPSRC and STFC. The other main (and increasing) source of income is EU government bodies, which makes up about 31 per cent of the current total. Our grant income has been growing steadily since 2008–09 at a rate of about 8 per cent p.a. Many of our new faculty have been appointed within the last year and have not yet had time to seek external funding. Thus, we would expect our research income to increase significantly in the near future.

Our research portfolio provides a high level of contribution income (39 per cent in the last four years). This – together with greatly increased student numbers – contributes to a highly sustainable Department The School delivered a surplus of ~£1M in 2012/13 following a surplus of £155k in 2011/12, and this surplus is available to the School in the future. The research grant income target for 2011/12 and 2012/13 were comfortably exceeded and, as of October 2013, the target for 2013/14 is already met.

Much of our research requires a high usage of central facilities provided by the Research Councils, especially in Astro (satellites/ground-based facilities), EPP (LHC-ATLAS), and theory (HPC: COSMA/COSMOS/ DiRAC-2). In addition, usage of non-RCUK facilities includes:

- *Astro* – 153 nights on the Anglo-Australian Telescope (nominal value AUD 3.1M);
- *Astro* – 152M cpu-hr on Teragrid, Juropa, XSEDE, PRACE (nominal value €7.6M, of which €1.3M as PI);
- *EPP* – The SNO+ and DEAP-3600 experiments, for which the M&O and construction costs are mainly funded by Canadian research funds (CFI);
- *EPP* – MINOS/MINOS+/NOvA all supported by USA DoE investment in Fermilab;
- *EPP* – French investment in infrastructure for the Double Chooz experiment; and
- *TPP* – 6M cpu-hr at CSCS (Switzerland) and CSC (Finland) – nominal value €0.3M.

Hence, by comparison with other Physics departments, we require proportionally less support from RCUK for local experimental activity and this will be reflected in a comparatively low *total* grant income but high *contribution* income.

The Department has benefited from around £10M in investment since 2008, comprising £2.45M from HEFCE for SEPnet, matching funds of £2.2M from the University, £2.0M from the University's strategic development fund for recent expansion, £2.7M in HPC, and £0.6M for lab refurbishments, with a further commitment from HEFCE and the University for SEPnet 2 which is not yet quantified.

The University's Strategic Development Fund allocated £2M to Physics for 2012–16 (21 per cent of the total across the University). The majority of this is for start-up awards to enable the development of new experimental activity in Physics and Astronomy. In addition to start-up costs, there is an on-going provision for the rolling refurbishment of existing labs. Over the REF period, this has included all EPP labs and the majority of those in AMO, at a cost of £553k.

During the period 2008–13, HEFCE invested £12.6M and 297 additional student numbers into SEPnet, matched by an investment of £12.8M from HEIs and a further £2.9M from other stakeholders. The combined investment at Sussex (£4.7M) included kick-start funding for faculty posts (4 at Sussex), technician support and postgraduate studentships, all specifically aimed at developing inter-institutional research links. Important elements were also the installation of video-

conferencing facilities to foster network graduate lectures, and dedicated outreach and industrial-liaison officers.

P&A has an Electronics Development Laboratory which provides a bespoke design-and-build service for specialised pieces of electronic apparatus, providing novel solutions on demand where commercial products are unobtainable off the shelf or where in-house design-and-build is more cost-effective. Examples of output from this laboratory include complete calibration systems for particle physics experiments, including MINOS, T2K, Double Chooz, and SNO+. We have access to both local (P&A) and central mechanical workshops – the former allows the rapid fabrication of specialised parts for physics experiments, while the latter is a fully equipped workshop with CNC machines for larger production runs. A diverse range of projects is undertaken, including high-vacuum and low-temperature systems. The School's 2013 planning-round submission last year was successful in securing more technical services support, in particular providing a new Grade 8 technical services manager.

SEPnet provides an equipment inventory to allow the sharing of specialist equipment and facilities across the region. Investment in the Chilbolton ground-station enabled SEPnet to become part of the international LOFAR radio array, and kick-started associated research at Sussex. It also purchased Sciama, a 1008-core, 85TB cluster, hosted by Portsmouth – primarily to support the work of the Astro/LOFAR theme within SEPnet – but also available to other researchers.

In 2010, P&A and the University jointly purchased a local HPC cluster. In 2008–12 the University has invested £2.2M in the machine room and standby generator. The total investment in hardware has been around £500k – most recently, in 2013, with an MPS investment of £114k in new nodes – and MPS have contributed 75 per cent of all hardware costs in total. The facility now has about 1,800 cores and 450 TB of Lustre parallel file system and 80TB of NFS storage. This has enabled Sussex to join, in September 2012, the Southern branch of GridPP (SouthGrid: http://www.gridpp.ac.uk/southgrid/). The University has also now been certified as a GridPP Tier-2 site and, as such, will support the ATLAS Virtual Organization (VO) and become fully integrated with the ATLAS Grid. The system will also support the SNO+ VO, once this is fully operational. The system has been much used for multi-processor code development and data analysis by the Astro, TPP and EPP groups.

The commitment of the University to the School extends into the future with a new Strategic Plan 2013-2018 committing to a significant, £120M, renewal of the Science Estate.

COLLABORATION OR CONTRIBUTION TO THE DISCIPLINE OR RESEARCH BASE

In Astro and EPP, in particular, but also in the other research groups, much of our world-leading research is achieved through wide international collaboration. In keeping with our strategic aim for excellence in a small number of fields, we engage in these collaborations not merely to make up numbers, but to be world-leading in our particular research niches. Our appointment strategy has been targeted at attaining this goal. We highlight some examples here:

- *Astro*: Large-scale simulation requires pooled expertise from international consortia: Thomas was a founding member and is on the Steering Group of the highly successful Virgo Consortium; with the arrival of Iliev, we also gained leadership in the DARE collaboration that is leading the way in petascale simulations of large-scale structure, including radiative transfer and feedback, exploiting the investment in LOFAR by SEPnet. An observational highlight is Oliver's leadership of the largest project on Herschel – HerMES – which, since 2010, has had 58 refereed journal publications (including 4 in *Nature*) and, as a project, has an H-index of 22.
- *AMO*: The group is engaged in collaborative activity throughout Europe and in the UK. Pioneering work on new hybrid quantum processors is being developed by Hensinger in the large European IOTA project (UK COST action representative). Garraway is developing new interferometers and sensors in collaboration with universities in Paris, and Verdu is setting up high-precision mass-spectrometry experiments in a German collaboration. Dunningham was PI on 'Quantum degenerate gases for precision measurements', involving 8 European partners and a budget of €1.95M funded by ESF.

- *EPP*: The group has a sustained leadership in the CryoEDM experiment (for which Harris is currently spokesperson) to measure the electric dipole moment of the neutron. It has played major roles in many neutrino-physics experiments (e.g. MINOS / MINOS+ / SNO / SNO+ / NOvA, etc.), focusing on leading the detection calibration, with roles on the science boards and executive committees (e.g. Hartnell, MINOS Executive Committee 2009–12). As an example of this leadership, Hartnell has recently won a €1.4M ERC grant to work on the neutrino-oscillation experiment, NovA, at Fermilab. In dark-matter detection, Peeters is one of the founding members of DMUK and soon-to-be Chair of the DEAP experiment. Sussex has an established leadership in most of the main searches for supersymmetry (weak SUSY, De Santo; tau-rich SUSY, Salvatore; stop searches, Vivarelli), as well as in the search for new physics in B-meson decays (Cerri is overall coordinator of the ATLAS B-physics group). Sussex also leads in areas of the ATLAS trigger (operations, core software, upgrades).
- *TPP*: Calmet is on the Steering Committee of the quantum black-hole group of COST action 'Black holes in a violent universe', and Hindmarsh is part of an international collaboration (Finland, Spain, Switzerland, the UK) to undertake supercomputer simulations of cosmological perturbations from phase transitions. Banfi and Sanz are invited expert members for several LHC Working Groups (CERN) to inform LHC experimentalists (ATLAS, CMS) and the particle-phenomenology communities. A significant collaborative development has been the expansion of the NExT Institute to include QMUL, RHUL, Southampton, Sussex (both EPP and TPP) and RAL. Funding from SEPnet and STFC led to 6 permanent positions, joint between theory and experiment and each involving at least two nodes. Under Sussex leadership (Litim, Steering Committee and Huber, Graduate School), the enlarged Institute has put in place a new international visitor programme as well as a novel graduate school (PhD and MSc degrees), which involves mixed (theoretical and experimental) training and supervision, networking across all nodes, student placements at the experiment locations (such as CERN) and in industry, the video-linked delivery of seminars and graduate lectures, tri-annual workshops and a yearly graduate conference. The NExT PhD School has become a role model for the wider GRADnet programme under SEPnet2. SEPnet also kick-started the successful TPP research consortium with RHUL, funded since 2011 by STFC-consolidated grants.

Two major components of SEPnet have been investment in outreach and links with industry. Through dedicated outreach staff within each department, the impact of our research, via public engagement, has improved dramatically. This is spelt out in detail in our impact cases but, during the academic year 2011/12, we engaged with 4,200 school and college students, 200 teachers, and a further 2,500 members of the general public. In addition, members of the Department regularly appear on TV and radio and online. As an indication of the success, P&A saw its applications for 2012 entry go up by over 100 per cent compared to 2011 (before the increase in student fees). This increase is reflected regionally (to a lesser extent), showing the value of this coordinated approach. The local outreach officers will be maintained in SEPnet-2 (paid for by the respective universities). The financial stability provided by this strong UG base underpins much of the investment in our research. SEPnet also provided, and will continue to provide, a central Employment Liaison Director, who provides links to local industries and co-ordinates the placement of students at partner institutes and with local companies. A major role of the regional graduate college, GradNet, will be to enhance the research skills and career prospects of PGR students.

Inter-disciplinary research is part of our strategy for controlled growth into new areas and as part of our longer-term impact-enabling strategy. The School is leading the development of a new interdisciplinary University Research Centre in Scientific Computing and Numerical Modeling.

- De Santo and Salvatore, as part of the SEPnet-RDI (radiation detectors and instrumentation) theme are working on the development of a Time-of-Flight PET scanner with nascent collaborations with applied and medical physicists.

- Keller and Thomas have a collaborative EPSRC grant (£800k) with the Department of Chemistry at Oxford to investigate ultracold chemical reactions between sympathetically cooled molecular ions and neutral molecules.

- Oliver has an STFC global-challenge award working with the Clinical Imaging Science Centre on transferring Astronomical statistical techniques to fMRI images of Alzheimer's disease patients, and projects with Cystic Fibrosis researchers at Dundee and Leeds and the European Cystic Fibrosis Society Patient Registry.

- Hensinger has started a joint research project with Anil Seth in Informatics and Mick O'Shea in Neuroscience to explore measuring and mapping brain activity using laser physics techniques.

Our expansion strategy benefits from our high esteem, which enhances our ability to attract and retain the best researchers. Here we list a few examples of research support and esteem indicators. This is not an exhaustive list:

- Seery was awarded a Philip Leverhulme Prize (2011), Peccianti was elected member of the Global Young Academy (2012), and Hartnell was awarded the IOP HEPP Group Prize (2013).

- Fellowships: Byrnes, Royal Society URF (2013–date); Garraway, Leverhulme RF (2006–08); Hartnell (STFC Fellowship); Hensinger, EPSRC Leadership Fellowship (2009–13); Pasquazi, Marie-Curie International Incoming Research Fellowship.

- Most faculty are Members or Fellows of InstP and/or FRAS. All faculty participate in the refereeing of papers, grant proposals, time-allocation committees, etc. Peccianti chairs the Optical Society of America.

- Members of grant-awarding panels over the REF period include Coles (STFC-AGP), De Santo (STFC-PPGP), Garraway (EPSRC), Harris (STFC-PPGP), Hensinger (EPSRC), Hindmarsh (STFC-PPGP(T)), Iliev (STFC), Romer (STFC), Thomas (STFC-AGP), Oliver (MRC Discipline Hopping Panel), and Peccianti (ESF pool).

- Members of Fellowship Panels include Dunningham (EPSRC), Garraway (Chair EPSRC 2007, 2012), Hensinger (EPSRC 2010), Hindmarsh (Royal Society URF), Litim (IRCSET 2008, EPSRC 2009) and Romer (STFC).

- Editorships: Calmet, Founding editor of the series *SpringerBriefs in Physics*; Hensinger, Guest editor for a special issue on ion trapping in *Applied Physics B*; Garraway, Editorial Board member/Section editor of *Physica Scripta;* Peccianti, Editorial Board member of *Scientific Reports*, *Nature* Publishing group; and Dunningham, APS Outstanding Referee Award 2013.

- Advisory boards: Peeters, IOP Astroparticle Physics Steering Group (2011–date); Harris, Nuclear and Particle Physics Sub-Committee, ILL, Grenoble (2006–09); Particle Astrophysics Advisory Panel (2009–11); and EDM Review Committee, Paul Scherrer Institute, Villingen, Switzerland; Hensinger, External Advisory Board for the EPSRC £6M COMPASS project; FARQUEST Group, a European Foresight Activity on Research and Technology in Quantum Information Science and European Strategy; Peeters, Advisory Panel for Fundamental Nuclear and Particle Physics of the ILL, Grenoble (2008–11); Salvatore, Member of the GridPP Institute Board; and Oliver, PPAN Programmatic Review Consultation Committee (*Space Science and Exploration*, 2008).

Faculty are regularly invited to chair and be members of Scientific Organising Committees for international conferences, chair sessions and give plenary talks. Examples include: Hartnell, IoP Meeting on Future Long-Baseline Neutrino Oscillation Experiments, UK, November 2012: opening plenary talk reviewing the current state of the field; Hensinger, Conference Steering Committee for the European Conference Series on Trapped Ions; Hindmarsh, Organising Committee for COSMO; and Oliver, Final Plenary Talk at ESA's 'Herschel First Results Symposium, 2010'.