Institution: Loughborough University

Unit of Assessment: B9 Physics

a. Overview

a1. The Unit is part of the School of Science and comprises 21 staff of which four are early career researchers appointed since 2008. This represents an increase of 25% FTE over this REF period. The research of the Unit is currently organised into **four main themes**: 1. **Quantum electronics and spintronics** (QElec), 2. **Quantum Engineering** (QEng), 3. **Novel Materials** (NM), and 4. **Physics of Extreme Conditions** (PEC). All four of these sub-units are covered by this submission. The themes where staff most actively participate are indicated in the following table:

	Alekseev	Balanov	Betouras	Berdiyorov	Chesca	Cropper	Everitt	Forrester	Gaifullin	Gulevich	Khomskii	Kovaleva	Kusmartsev	Kusmartseva	Morrison	Samson	Saveliev	Slizovskiy	Sobnack	Swallowe	Zagoskin
QElec	X	X			X		X	X	X	X				X			X	X		X		X
QEng		X	X				X										X	X				X
NM			X	X	X	X		X	X		X	X	X	X	X				X		X	
PEC										X				X	X						X	

b. Research strategy

There is significant overlap between the Unit's research themes, resulting in a substantial volume of high quality collaborative research across sub-units that is indicative of the successful implementation of the Unit's strategy as presented in RAE 2001 and further developed in RAE 2008. This model also underpins the Unit's strategy as presented here where the Unit successfully provides a vibrant, collaborative and sustainable research atmosphere that capitalises on its research expertise. The policy of inviting internationally established visiting researchers, such as Rashba and Bianconi, supports our activity and provides an atmosphere which greatly enhances the quality of the Unit's research environment. Staff within the Unit maintain strong international research connections (including collaborations with leading research institutions in Europe, USA, Canada, Japan and Russia). This approach has enabled the Unit to develop its research profile and portfolio within its strategic themes resulting in activity that is internationally competitive, aspects of which are world leading.

Vision and strategic plans:

b1. Since RAE 2008 the Unit has continued to expand from its recognised internationally excellent, and in places world leading, position. In response to feedback, the Unit has reviewed its activity and made a decision to expand its experimental research base in a way that complements existing theoretical expertise. In particular the Unit prioritised expansion in two research areas. The first being ***Novel Materials*** and ***Physics of Extreme Conditions***. The second being ***Quantum Engineering*** which has been identified as a hot topic where the Unit will develop support of an existing strong theoretical body. The unit has already realised the first of these priorities with the appointment of ***Betouras***, ***Kusmatseva***, ***Forrester*** and ***Morrison***. This represents a significant expansion in the Unit's staff (25%) and experimental research base. As a first step to addressing the second priority ***Everitt*** has moved to a 1.0FTE open ended contract.

b2. **The vision** for the Unit in 10 years' time is to be conducting research that is consistently internationally leading in: ***Quantum Electronics and Spintronics***, ***Quantum Engineering*** and ***Novel Materials*** and related topics. The Unit anticipates it will also remain internationally competitive in a wider range of topics including involving interdisciplinary research.

b3. **The strategic aims and objectives** of the unit are to:

i. ***Concentrate on research themes*** *(sub-units):* (1) Quantum Electronics and Spintronics, (2) Quantum Engineering, (3) Novel materials and the Physics of Extreme Conditions which, building on synergies of its participants, will merge into a single strongly focused theme to further enhance the Unit's research base to meet its strategic needs.

Current Position: The Unit's portfolio of published work consists of almost 300 journal

publications since 2008 the vast majority of which are in these areas of research. We have also as a unit invested in the appointment of Drs Betouras (quantum engineering and novel materials), Forrester (quantum electronics and novel materials), Kusmartseva (novel materials and extreme conditions), Morrison (novel materials) and the conversion of Dr Everitt (quantum electronics and engineering) from a fixed term fractional to an open-ended full time contract to strengthen those areas.

ii. ***Strengthen the experimental activity within the Unit***. The Unit has already successfully realised part of this objective and now plans to expand its staff in experimental research areas through the appointment of experimentalists in the quantum engineering area. As part of the University's £60M West Park Redevelopment we have embarked on the creation of a new world-class integrated science & engineering research facility in partnership with 6 other Departments. The co-location, enhancement and investment in research infrastructure will provide a significant increase in the experimental research capabilities available to our staff.

Current Position: The experimental base has seen expansion in staff numbers through the appointment of Drs Kusmartseva and Morrison. In addition we have recently appointed an experimental officer. Since RAE 2008 the Unit and University has invested £1.1M in improving its experimental research facilities. This includes: TEM; X-Ray diffractometers with high and low temperature stages, parallel beam and rapid phase analysis; Pulsed Tube Cryostat; Electron Microscope Analytical System upgrades.

iii. ***Ensure that the Unit's research continues to have impact and reach far beyond its institutional boundaries***. The Unit will continue to support and encourage the development of strong and stable research collaborations between its staff and leading research institutions, especially where their expertise and experimental capacities complement those of the Unit's research themes (sub-units). The Unit will continue to publish its work in leading scientific journals and disseminate its research at national and international conferences as well as seek to publicise its research beyond the academic community. Evidence of the Unit's commitment to impact can be found in REF 3a.

Current Position: Details of our research collaborations between the Unit's staff and leading research institutions can be found in section **e.** The Unit currently benefits from the active participation of 8 visiting staff the vast majority of which are international. Within this REF period over 90% of staff within the Unit have published with international co-authors and with collaborators within the UK. In terms of extending our reach beyond the academic community approximately one third to one half of the Units staff have active links with industrial, governmental or similar partners. See section **e.** for details. In terms of evidencing the Unit's commitment to impact we note that within this REF Period we have spun out Sonobex and filed five patents. Note that the Sonobex spin out forms one of the case studies in REF 3 where more details can be found.

iv. ***Continue to encourage a dynamic, effective and inclusive research environment***. The Unit's use of open working groups, and its fair, friendly and open atmosphere ensures the free exchange of information, mutual support and collaboration between the Unit's research associates and research students. The environment and vitality of the Unit is enhanced through activities ranging from regular seminars to social events.

Current position: With the exception of the Unit's most recent appointment all staff that are part of this REF return have published with at least two other people within the Unit (with some having co-authored across their portfolio with more than 50% of the Unit). Typically there are 30 to 40 seminars per year, featuring leading researchers from top UK and international research institutions. Over the last 18 months we have had speakers from St Andrews, Cambridge, Copenhagen, Harvard, Imperial College, Jena, Karlsruhe, Leiden, Madison-Wisconsin, Max Planck Institute, NII (Japan), Oxford etc. (Prof. Chalker, Prof. Dubrovich, Prof. Eaves, Prof. Essler, Dr Garcia-Garcia, Prof. Joynt, Prof. Mackenzie, Prof.

Sachdev, Prof. Spiller, Dr Touchette, Prof. Zaanen, and others).

The Unit has joined the Institute of Physics Project Juno initiative (see section c7.i.).

b4. In response to comments received from RAE 2008

i. In the feedback to RAE 2008 it was noted that the visiting and part time staff added immediate vibrancy to the Unit. Many of the visiting staff at the Unit are the same as in RAE 2008, and one part-time fixed term staff member is now employed on a full time open-ended basis and two others continue to be employed on a part time basis, demonstrating continuity and addressing the concern of the sub panel on the long term effects on the research environment.

ii. At the last RAE the Unit averaged £144k per annum (excluding research council facility in-kind income – which has remained approximately constant) and during the current REF period this has increased nearly three-fold to £407k per annum. We have seen a large increase in our income and expect to see this rise as our experimental activities develop. The Unit has also doubled its PhD award levels from an average of 2.5pa to 5.1pa since RAE 2008.

iii. The sub Units have been reformed to provide fewer more substantial and well-focused themes. Details of this were given in section **a**.

iv. The Unit is in a stronger financial position and has a more dynamic, effective, inclusive and sustainable research environment than in 2008.

c. People:

c1. **The Unit has an on-going strategy** of hiring a core of outstanding full time academics with the potential to be subject leading. This is supported by a cadre of international experts (visiting or part-time employed) forming a dynamic and integral part of the Unit. The Unit provides a thriving and productive research environment and a forum from which early career researchers and students derive great benefit.

c2. **Our strategic aims** are to:

i. Attract and retain high calibre staff from the national and international community in order to support the Unit's research strategy and teaching requirements.

ii. Reward excellence and sustained contributions to the Unit and discipline.

iii. Identify, support and develop staff capabilities and impact generation in research & teaching.

iv. Engage with national frameworks that enable the Unit to make clear its commitment to equality and diversity.

v. Host outstanding visiting researchers in order to strengthen and develop external collaborations and impact.

c3. **Stability and Sustainabilty** - Before proceeding to discuss details we note that in the REF period ***no permanent members of staff have left the Unit*** other than through normal retirement. This outstanding retention of staff demonstrates the on-going effectiveness of our staffing strategy.

c4. **Career development** is supported at all stages by an ethos of collegiality that enables, for example, staff to engage in research visits with specific support as detailed below.

i. The development and nurturing of ***early career researchers*** (both academic staff and RA's) plays a major role in the Unit's strategy and they are consistently given opportunities and encouragement to present and develop their own ideas. Their development is

supported by opportunities and active encouragement to attend conferences and spend time at collaborating research institutions abroad. For example Dr Kusmartseva was given leave of absence to pursue her Humboldt Fellowship in Munich. The Unit also supported numerous other visits such as Wilson (RIKEN), Forrester (H. Hilgenkamp at Twente U. in the Netherlands), Slizovskiy & Cole (Max Planck Inst. Dresden) and Wu, Berdiyorov (U. of Antwerp). Another example of support for early career staff is the Unit's support of Morrison during the commissioning of her laboratory. During this period, in order to provide her with continuity of research, the Unit is supporting her use of laboratory facilities at Imperial College. Her research has been further supported by the Unit through the award of a Small Grant and in kind use of thin film deposition and related facilities. Early-career staff are encouraged to closely interact with and guide research students under the supervision of more experienced staff. The University's Staff Development Unit provides additional support through regular training sessions such as *Publish or Perish? Raising your Profile as a Researcher*.

ii. Mid-career staff are supported through various mechanisms including a sabbatical scheme, small grants (for conferences and research visits), PhD studentships and career development opportunities that are organised by the University's Staff Development Unit (which provides courses such as *Winning Grants* and *Funding for the Enterprising Researcher*). Evidence of successful rewards processes for mid-career staff in this REF period are the promotion of Zagoskin from Lecturer to Senior Lecturer then Reader and Balanov and Betouras to Senior Lecturer.

iii. The Unit and University also supports external career development opportunities that enable impact beyond institutional boundaries. For example, Elford has undertaken training by the Institute of Leadership and Management as well as courses at Cambridge Business School. The success of such initiatives is evidenced by Elford leaving the Unit to become CEO of a University spin-out company.

iv. In addition to sabbatical schemes senior staff benefit from career development opportunities that are organised by the University's Staff Development Unit (such as *Academic Probation Adviser Training* and a range of courses run by the *Institute of Leadership and Management*).

v. The Units implementation of the *Concordat to support the Career Development of Researchers* is organised centrally by the University. Loughborough University comprehensively analysed our alignment with the Concordat in 2009/10, and published an implementation plan in 2010, for which it received the European Commission HR Excellence in Research Award. The plan was up-dated in 2012. Monitoring takes place through participation in the Careers in Research Online Survey, and through the 2012 University-wide Staff Survey, for which the Research Job family had the UK's highest number of 'green' categorised responses (10% above the institutional average). Performance and Development reviews are in-place for all staff, and up-take for research staff is being strongly encouraged. The staff development strategy specifically includes Leadership and Management. Research staff can also attend courses run by the Graduate School, Careers and Employability Centre, and Staff Development courses. Early Career academic staff undertake the New Lecturers Course, with support available from the Research Office. Opportunities are regularly disseminated to Schools by the Research Office. Mentoring is available for research staff, and academic staff are encouraged to participate as mentors. The Research Office provides bespoke one-to-one support for staff writing grant proposals, which further enhances the Research Culture. Improvement of Research performance across all disciplines has been a key priority, and all academic staff complete an annual Personal Research Plan. This process embeds research in performance monitoring and reward systems and is monitored by the University's Research Performance Monitoring Committee, chaired by the Pro-Vice Chancellor for Research.

c5. There are four **personal research fellowships** currently held by the Unit: ***Kusmartseva***

(Humbolt), ***Saveliev*** (Leverhulme), ***Slizovskiy*** (EPSRC Research Fellowship) and ***Berdiyorov*** (Marie Curie Fellowship). In addition ***Elford*** (currently director of Sonobex) was the youngest ever recipient of the Royal Academy of Engineering Fellowship (which finished in 2013).

c6. **The Unit has a significant level of international staffing**:

i. Approximately 70% of staff within the Unit are of international origin. Dr Neumann is on leave of absence to take up a senior position at the University of Kurdistan.

ii. Visiting staff since 2008 comprised more than 30 researchers, including: **Abrikosov** (Nobel Laureate 2003 - Argonne), **Rashba** (Rutherford Professor in Spintronics and recipient of the 2007 Pekar prize-Harvard), **Chubukov** (Leverhulme Visiting Professor, U. of Wisconsin-Madison, USA); **Asai** (seconded to the Quantum Engineering Group from AIST –Tsukuba, Japan); **Rakhmanov** (Institute of Theoretical and Applied Electrodynamics, Russia); **Kugel** (Institute of Theoretical and Applied Electrodynamics, Russia); **Kravchenko** (Northeastern University, USA); **Boris** (Max Planck Institute Stuttgart, Germany); **Fromhold** (Nottingham, UK); **Saarela** (Oulu University, Finland); **Marchesoni** (U. di Urbino, Italy); **Kürten** (TU Wien, Austria); **Sowa** (U. Saskatchewan, Canada); **Maassen van den Brink** (National Taiwan University, Taiwan).

c7. Equality and diversity

i. The Unit is currently undertaking a process of formalising its commitment to equality and diversity. As the Unit is too small to take advantage of Athena SWAN we are determined to pursue our equality and diversity agenda through the Institute of Physics' ***Project Juno*** scheme (which seeks to address the underrepresentation of women in University Physics) The unit is currently a Juno Supporter and is targeting Practitioner and, ultimately, Champion status. The Unit has a strong track record of attracting outstanding applications for all its appointments and was pleased that for the last two the best were from female physicists (Kusmartseva and Morrison).

ii. University policies ensure equality of opportunity and freedom from discrimination. Recruitment of all students is in accordance with the University's formal admissions policy. The student's supervisory team is supplemented by a Director of Research Degree Programme who can assist in the resolution of any issues. Applicants with disabilities are invited to identify any special needs or support requirements they may have and they are supported in their programmes of study through the University's Counselling and Disability Service.

c8. Research students

i. The Unit has supervised **61 research students** over this REF period which it strongly and systematically supported in their training and career development. It is part of the **Midlands Physics Alliance.** Currently this gives our students access to the existing modules in the Midlands Physics Alliance Graduate School and the Unit has recently commissioned an access grid facility to enable active participation in the School.

ii. Academic support for the students is provided by the research degree supervisors. It has recently become the Unit's policy to allocate second supervisors to strengthen the provision of formal support. Research students are fully integrated into the research culture of the Unit through membership of research sub-groups and attendance at research seminars and conferences. The University offers a wide range of support facilities, including the Graduate School, the Student Advice Centre, the Research Student Office in the Registry which provides dedicated administrative support to research students, the Maths Learning Support Centre and the English Language Support Unit. Among other support programmes, the Graduate School offers the 'Café Academique', a forum where PhD students can debate the latest ideas from all areas of research. The Careers and Employability Centre have a dedicated Careers Advisor, to support research staff and research students.

iii. A major academic progress review, against published criteria, is held at the end of each year of registration and students are required to produce a significant piece of written work as well as undertake an interview with an independent assessor before being permitted to progress to the next year of registration.

iv. The Graduate School, in partnership with the academic Schools, is responsible for the delivery of transferable and employability training to meet the requirements of the Researcher Development Framework. The Graduate School co-ordinates a programme of training and a series of workshops and events. The University Careers and Employability Service provide a specialist service for research students and organises an annual event for doctoral students to meet and network with employers who have specific opportunities for PhD applicants. The Graduate School organises many events to enable students to participate in the University's research culture. In addition research students have the opportunity to attend local external conferences and events such as Engineering YES and the East Midlands University Association Postgraduate Conference. The Graduate School has a conference fund to support student attendance at national and international conferences.

v. With around 60% of its PGR admissions being internal the Unit is in the process of reviewing its recruitment process with a view to significantly increasing the diversity of its PGR base. The Unit recognises the discipline specific issue of underrepresentation of women in university physics and, as such, the revision of our strategy will be done in-line with the Unit's activity in project Juno.

d. Income, infrastructure and facilities

d1. The Unit's research is supported by a wide variety of funding from EPSRC, John Templeton Foundation, ESF, EU, STFC, Royal Academy of Engineering, the Leverhulme Trust and the Bank of England. The current total value of active grants is £1.4M with an average annual income over the REF period of £454k The in kind contribution from leading research institutes such ILL, ISIS, Diamond, Daresbury, CERN,HMI, NII Japan, totalled approximately £4M since RAE 2008.

d2. **The Unit contributes to the University's Materials Research School** which facilitates research collaborations in the departments of Materials, Chemistry, Physics and the Engineering Schools. Independently and through the Materials Research School the Unit continually invests in and gains access to a wide range of research equipment which is located both in the Unit and in the collaborating departments (clean room, high-frequency measurement equipment, focussed ion beam, electron microscopes, IR, Raman and x-ray systems, calorimetry and dilatometry, sample preparation, Auger, mass spectrometry, universal test equipment, optical microscopy, high speed IR and optical cameras, etc.). Each of these specialist facilities has a responsible staff member who trains users or will assist in obtaining relevant measurements. As part of the university's strategy within the REF period, £7.4M of Research Capital Infrastructure Funding investment has been made into renewing research infrastructure and equipment much of which has been used to improve research equipment within the Materials Research School. Recent appointments, Morrison and Kusmartseva, each received, in addition to in-kind support, £10,000 Science School funded new lecturers' start-up grants to assist in the initial setting up of their laboratories and they are eligible to bid, as priority cases, for further Science School and departmental (Unit) funding.

d3. **The Unit's staff benefit from access to the High Performance Computing service**, a parallel computing facility in support of research activity within the University. The service is composed of two clusters totalling over 5,000 cores with associated disc space, which supports a number of projects across the unit. Everitt represents the Unit's interests on the management committee of the facility.

d4. An important component of the **£60M 'The West Park project'** is the sharing of research facilities in interdisciplinary laboratories. It will completely refurbish the 1970's buildings in which these departments are situated, provide 'state-of-the-art' research facilities and consolidate closely related research equipment held in several Units. This consolidation of research infrastructure utilises synergies and complementarities between research equipment in different Units (e.g., X-ray

diffractometers, thermal analysis equipment, mass and optical spectrometers etc.), and will give the researchers the use of modern multi-facility units in a convenient and efficient way. The implementation of this plan is scheduled for 2014-2018.

d5. The **University Research and Enterprise Offices provide professional research support** offering a complete service for the costing and pricing of research grants and contracts, facilitating interdisciplinary bids. It also actively targets funding opportunities, supports drafting of applications and negotiates legal agreements and assists in patent applications as well as providing financial support for enterprise activities on an on-going basis.

d6. **Consultancy:** staff provide consultancy services to a range of UK and overseas agencies, examples include Korean and Kazakhstan governments (Kusmartsev), Morgan AM & T, and Simpact (Swallowe), Higher Education Academy (Zagoskin), European Commission and the IoP quantum curriculum project developing a novel approach to teaching quantum mechanics at the undergraduate level (Everitt).

e. Collaboration or contribution to the discipline or research base

e1. During the REF period the Unit has **made significant contributions to the discipline**. ***Key examples*** include: **(i)** In **collaboration with researchers from RIKEN** (Japan), Universities of Nottingham, Bath, Augsburg (Germany), and Oulu (Finland) the Unit's researchers developed the theoretical basis for new devices to generate, amplify and detect terahertz electromagnetic radiation (T-rays). **(ii) A new theory of electronic phase separation in cuprate oxides** was developed in collaboration with Kabanov, Rashba, Saarela. Further collaboration with Kornilovitch at Hewlett-Packard led to the development of a new theory of superlight lattice bipolarons extending the bipolaron theory of high-temperature superconductivity. **(iii) The first experimental realization of electromagnetic metamaterials** designed to operate at zero frequency and applicable to non-intrusive screening of weak d.c. magnetic fields, was achieved in collaboration with Pendry's group (co-author Morrison now in the Unit) at Imperial College (reported in an influential paper in Nature Materials (2008). **(iv) The feasibility of commercial adiabatic quantum computing devices** was demonstrated in collaboration with experimentalists from NEC (Japan) and reported in Science, 2010. Experimental prototypes are being developed in a close collaboration with the experimentalists from the IPHT-Jena and Karlsruhe Institute of Technology (Germany). **(v**) **Important progress has been made in understanding the physics of graphene, silicene and other novel materials** (e.g., germanene) Nano Letters, 2012. **(vi)** In collaboration with the University of Nottingham**, a novel approach was discovered to creating quantum dots**, with the possibility of a direct non-destructive laser writing technique capable of producing nanoscale light-emitting diodes. Results were published in Phys. Rev. Lett. 2008 and featured in Research Highlights of Nature Nanotechnology and Nature Martials. **(vii)** In collaboration with Bath and Cambridge **a new class of semiconductor structures** was devised that accurately imitate the electrical activity of biological neurons with results published in Phys. Rev. Lett. 2009 **(viii) A fruitful cross fertilisation between traditional acoustics and physics of metamaterials, resulted in the development of acoustic metamaterials.** Patents for these novel sound barriers have been secured. A spin–out company, SONOBEX Ltd. was formed in May 2013 to commercialise this work. **(ix)** In collaboration with Forro group (EPF, Switzerland**) a new type of superconductivity arising under very high pressure, and a new state of matter were discovered** and reported in Nature Materials 2008 **(x)** In astrophysics, the Unit's researchers **solved the mystery of Saturn's moonlets and of planet formation in protoplanetary disks** (Scientific Reports, 2013). **(xi)** Everitt made contributions to the foundations of quantum mechanics – such as the quantum to classical transition and measurement problem with results published in New Journal of Physics 2009 and elsewhere.

e2. **The Unit supports its staff in developing and sustaining collaborations via several mechanisms as outlined section c.5 of this document.** Through this approach the Unit benefits from a number of active collaborations with academic and non-academic users including: ***Alekseev*** (Oulu, Nottingham), ***Balanov*** (Nottingham, TU Berlin, Imperial, Cambridge, Sheffield, Dresden, Jožef Stefan Institute, Copenhagen, Saratov State University, CNRS), ***Chesca*** (Tübingen, Munich, Twente, Nottingham), ***Cropper*** (STFC), ***Everitt*** (Queensland, Leeds, Liverpool, Jena, Hewlett-Packard, National Institute of Informatics Japan, Nippon Telegraph and

Telephone Corporation, RIKEN); ***Forrester*** (UCL, Stanford, Vienna, NTU, Institute for Cytology and Genetics - Russia), ***Gaifullin*** (Bath, Nottingham, Kyoto, Moscow State, SuperOx Japan and Russia), ***Gulevich*** (Bayreuth, Oulu, RIKEN), ***Kusmartsev*** (Vienna, RIKEN), ***Kusmartseva*** (Edinburgh, EPFL, Munich, Kyoto, Imperial, Glasgow), ***Morrison*** (Imperial, Dresden, TU Darmstadt, Delft, AMES – US Department of Energy, IMRIM Italy), ***Samson*** (Hewlett-Packard, CINT Los Alamos) ***Saveliev*** (Augsburg, Antwerp, Cape Town, Camerino, RIKEN, Hewlett-Packard, Salk Institute), ***Swallowe*** (Imperial, DSTL, Morgan AM&T), ***Zagoskin*** (IPHT, RAS, Queensland, British Columbia, Leeds, Academia Sinica, RIKEN, NEC, National Institute of Advanced Industrial Science and Technology Japan).

e3. **The Unit is active in *interdisciplinary research*** in the areas of ***psychophysics*** (***Saveliev***) and ***econophysics*** (***Kusmartsev***, ***Saveliev***). In collaboration with the ***Salk Institute*** for biological problems, ***Saveliev*** has developing a new branch of optimal planning models describing behaviour of humans in complex video game environment. This project is currently funded by a ***Leverhulme Trust*** research fellowship. Application of methods of theoretical physics to human decision making will open a new avenue for robotics and artificial learning. ***Kusmartsev*** and ***Saveliev*** are conducting an econophysics research project together with the ***Department of Economics***, supported by the ***Bank of England*** which seeks to understand volatility and the stability of the banking system.

e4. **Examples of leadership in the academic community and beyond include: *Kusmartsev*** is advising the governments of South Korea and Kazakhstan on science policy. He is also in collaboration with the Bank of England, the outcome of which will influence policy making in the UK. In addition ***Kusmartsev*** chaired the European Network Programme AQDJJ consisting of 72 Universities in 14 countries and has served continuously on three international advisory boards: PLASMA, Superstripes, International Workshop on Superconductivity. ***Balanov*** has been the invited chief researcher and head of group at Saratov State University within the special target programme of the Russian Ministry of Education and Science. ***Swallowe*** advises the Czech academy of science on selection of experiments at the Řež Neutron Research Facility. ***Kusmartsev***, ***Samson*** and ***Saveliev*** are members of the EPSRC College. ***Everitt*** was an author for the Institute of Physics new quantum curriculum project targeting improved teaching of quantum mechanics across the UK HE sector. ***Kusmartsev*** is an editor for *Scientific Reports (NPG)* and *Advances in Condensed Matter Physics.* ***Zagoskin*** is an editor for the *Journal ISRN Condensed Matter Physics*. ***Khomskii*** is a member of the organising and program committees of numerous international conferences including *APCPT workshops on multiferroics*, 2008–2013 (Korea, Taiwan, Japan, China, Singapore), *Tokyo–Cologne Workshop on Strongly Correlated Transition Metal Compounds* Germany 2011, and *Novel Materials: Adding Material-specific Reality In Physicist's Models* 2012.

e5. **Keynote talks and conference chairs** have included: ***Balanov*** (Chair at Interdisciplinary symposium on complex systems in Greece & Czech Republic [2011, 2012 and 2013] and six keynote talks including: THz Radiation and Metamaterials Spain 2009; 4th Workshop on Quantum Chaos and Localisation Phenomena, Poland 2009; Fluctuations and Coherence: from Superfluids to Living Systems, Lancaster 2011), ***Everitt*** (Chair at IoP Conference Quantum Technologies taking concepts through to implementation London 2012, Keynote at XXII Foro de Física, Mexico 2012), ***Forrester*** (Chair at Composites for Nano-Engineering, USA 2010, keynote at Applied Nanotechnology & Nanotoxicology, Russia 2013), ***Kusmartsev*** (has been a keynote speaker at at least 22 international conferences, chairman at least 17 as well receiving a golden certificate for the invited lecture on the International Conference on Superconductivity and Magnetism, (ICSM2012) Turkey, May, 2012), ***Morrison*** (Chair at DICNMA, Spain 2013); ***Saveliev*** ("Friedrich Wilhelm Bessel Research Award" in 2009, Keynote talks in International Workshop on Nanostructure Superconductors series in Germany as well as Bristol and Bath).

e6. The Unit has three IoP Fellows (***Kusmartsev***, ***Saveliev*** and ***Zagoskin***) and two APS Fellows (***Kusmartsev*** and ***Saveliev***) with other members of the Unit also acting as panel members for the award of CPhys status.