Institution: University of Central Lancashire

Unit of Assessment: 9 Physics

a. Overview

Since the 2008 RAE there has been substantial development and investment in Physics and Astronomy research at UCLan. These subjects come under the auspices of the Jeremiah Horrocks Institute (JHI) for Mathematics, Physics & Astronomy. The JHI has its own Director and is an organisational entity within UCLAN.

The University is strongly committed to the Physical Sciences, and it has invested heavily in the JHI since 2008 in a number of ways (described in more detail below). For example, the University created a new inter-disciplinary Institute of Nanotechnology and Bioengineering, which includes the JHI Nano-Physics and Magnetic Materials Group, as well as researchers from Chemistry, Forensics and the Bio-sciences, and which occupies a part of the new £11.5 million J B Firth building (opened September 2011). The University funds its own High-Performance Computing Facility (UCLAN-HPC), of which the UoA accounts for over 80% of the usage. The University also appointed externally a new JHI Director in 2012, reinforcing its commitment to the JHI.

The present REF submission represents the breadth of activity across the JHI in terms of outputs and impact, both nationally and internationally, within academia as well as in industry. For example, the Solar Physics Group, headed by Walsh, has worked with NASA on building the Hi-C solar observing camera, which was launched on a sounding rocket from the White Sands Missile Range, and which produced the highest ever resolution images of the magnetic filamentary structure of the solar corona. The JHI also hosts the UK Data Archive for the NASA Solar Dynamics Observatory (SDO), and has done so ever since SDO was launched in 2010.

The Stellar Astrophysics Group has collaborations with the Kepler Space Mission (Kurtz is a member of the Kepler Steering Group) and the Herschel Space Observatory (Ward-Thompson is a member of the Herschel-Spire Consortium). The Extra-Galactic Astrophysics Group is also heavily involved in Herschel (Popescu and Sansom are members of the Herschel GAMA and H-Atlas consortia respectively). There is also a strong theory component of the Extra-Galactic Group that uses the UCLAN-HPC facility, as well as being one of five equal partners in the DiRAC-COSMOS consortium.

The Nano-Physics and Magnetic Materials Group works on such topical physics as nano-structured soft matter and the applications of graphene and fullerenes to solar cells. They have strong links with Japanese industry (via the Zeon Corporation) and with various industrial corporations in the USA (via the INSIC Consortium), as well as with multi-nationals (such as Accelrys). In addition, this group has recently provided the first theoretical explanation of the Peterson-Kruger Effect (Mercer & Bissell 2013) in scanning column magnetometry. This document sets out the overall environment within which the UoA9 submission sits, including an outline of goals achieved during the current reporting period and strategic visions for the future.

b. Research strategy

The 2008 RAE return from this UoA9 group stated in the environment case that we would “aim to develop areas of strength, so that new staff, projects, or research avenues should relate to existing core strengths”. This strategy has been pursued vigorously during the current reporting period. One example of this has seen the targeted strategic growth of the **theoretical** nano-physics area around the leadership of Zvelindovsky, who was promoted to a Personal Chair in 2009. This has included the appointments of Pinna (2010) and Mura (2011). Pinna was awarded the 2009 IoP Thesis Prize for the best computational physics thesis in the UK that year.. These 3 staff members currently have 6 post-graduate students between them. This group is strongly supported by the University’s strategic investment in an HPC facility, of which they are amongst the heaviest users. It remains part of our ongoing **strategic vision** to continue to support and grow this fertile area.

A five year Strategic Development Plan (2011-2016) for Mathematics, Physics and Astronomy in the JHI, in research and teaching, has been recently approved by the University (in 2011). Essentially it encapsulates and supports the principles mentioned above of developing areas of strength and supporting core areas of research. It includes an overall strategy for support of development and focussed growth of current core areas of research strengths within Astrophysics, Solar Physics and Nanophysics, together with development of Pure and Applied Mathematics.

Examples of the start of the implementation of the plan include the appointment of a new JHI Director in 2012 (Ward-Thompson - see below) and the appointment in 2012 of a new Physics lecturer (Bibby). The Plan includes the appointment of new lecturers in each of the successive years of the Plan (2014-16). The appointment of 2 Guild Fellows in 2013 (see below), in addition to the above appointments, is part of University's overall strategy for research, over and above the expansion envisaged within the JHI 5-year Plan.

The University appointed (externally) a new JHI Director in July 2012, Professor Ward-Thompson (formerly Deputy Head of Physics & Astronomy at Cardiff University), and simultaneously continued the contract of the outgoing Director for a 12-month overlap handover period. There have only been 4 holders of this post (formerly Director of Observatories) since 1947 (Barocas, Robson, Bromage and Ward-Thompson), and each has been appointed from outside of the University, thus ensuring both long-term stability and a periodic injection of fresh ideas.

Also in 2012, the University funded a scheme of `Guild Fellowships', in which outstanding up-and-coming researchers were invited to apply for 5-year fellowships (akin to RCUK Fellowships), which entail 5 years of (independent) research-only work, leading to a guaranteed permanent faculty position. The University only offered 14 Guild Fellowships in total across all subjects, but such was the strength of Physics applicants that 2 of the 14 Fellowships came to the JHI – one in Astrophysics (Stamatellos) and one in experimental Nano-Physics (Smerdon). This demonstrates both the calibre of these Fellows and the strength of the University's commitment to supporting Physics as a whole.

The 5-year Plan is therefore continuing our on-going strategy of appointing in areas of strength, and growing these where possible. Consequently, the appointments of Bibby, Ward-Thompson and Stamatellos, all in the area of Stellar Astrophysics, has allowed that area to grow to a critical mass of 5 academic staff, similar in size to that of the other groups (there are additionally 4 PhD students and 1 PDRA in the Stellar area). The **strategic vision** in this area is to continue to support and grow this research area with further appointments.

The appointment of Smerdon in the area of **experimental** Nano-Physics, represents a strengthening of our laboratory-based Physics activity. The University has funded a new laboratory, which has been refurbished and equipped for Smerdon with a Scanning Tunnelling Microscope (STM) and a Spot Profile Analysis Low Energy Electron Diffraction Optic (SPA-LEED), in addition to giving him a start-up grant. This is in part intended to replace staff members who have retired or moved on, but in part to move into this exciting and rapidly maturing field. Smerdon will work alongside Mercer, who specialises in magnetic materials, and has a well-stocked magnetics laboratory, as well as a laboratory containing an Atomic Force Microscope (AFM) and two Electron Microscopes in the new J B Firth building (opened 2011), described above. The **vision** in this area is to grow a significantly larger research activity around these young experts in the field. Mercer currently has 1 PhD student, and Smerdon has already won a Royal Society Research Grant.

This REF submission includes **20.9 Category A staff** members (over 80% of all eligible staff) in four groupings:

Stellar Astrophysics (5 Cat A) includes research into the physics of stars: Bibby, Eyres, Kurtz, Stamatellos and Ward-Thompson.

Extra-Galactic Astrophysics (5.9 Cat A) includes research into the astrophysics of galaxies: Cawthorne, Clowes, Debattista, Gibson, Popescu and Sansom (who is employed on a 0.9 FTE contract).

Solar Physics (5 Cat A) includes research into solar coronal and solar-terrestrial physics: Bewsher, Brown, Dalla, Regnier and Walsh.

Nano-Physics and Magnetic Materials (5 Cat A) includes both theoretical and laboratory research into Nano-Physics and Magnetic Materials: Mercer, Mura, Pinna, Smerdon and Zvelindovsky.

The **Stellar Astrophysics** group's investigations and **future strategic directions** cover three main areas:

Asteroseismology: probing the internal structure and atmospheric structure of early-type stars with both high-resolution spectroscopic and high-precision photometric analysis techniques developed in the JHI. The former uses allocated observing time on the largest ground-based telescopes (e.g.

VLT, Subaru, and the Southern African Large Telescope, SALT, for which the JHI has guaranteed time as a founding partner in the project). The latter is based on data of revolutionary quality and precision from the NASA Kepler mission (Kurtz). This research includes and will include (a) studying the tidal driving of pulsation and the so-called heart-beat stars, (b) peculiar and extreme chemical abundances, radiative levitation and very strong magnetic fields, and (c) studying Ap-star atmospheres in 3D using time-resolved spectroscopy.
Key late stages in stellar evolution: including very-late-thermal-pulse objects, novae and dust formation in stellar ejecta (Eyres; Bibby). This work is based on established on-going research collaborations and the subgroup's experience in molecular spectroscopy and radio interferometry. It has used the NTT, CTIO, SAAO, Merlin, VLBA, Effelsberg & GMRT, and will also use SALT, SOFIA, ALMA and e-Merlin.
Star formation: This is a new direction undertaken by the JHI since the 2008 RAE, with the appointments of Ward-Thompson and Stamatellos (see above), the former in observational star formation and the latter in theoretical star formation. Since his appointment in 2012, Ward-Thompson has published a paper in Science, been awarded a PDRA by STFC, and won telescope time on ALMA against a fierce over-subscription rate of over 10:1. He has one STFC-funded PhD student and was awarded a second studentship by the University to further support this area. This research has made heavy use of the Herschel Space Telescope (Ward-Thompson is an Associate Scientist on the Herschel SPIRE Consortium) and the JCMT (Ward-Thompson is one of the 4 co-PIs of the JCMT Gould Belt Survey), as well as interferometers such as IRAM and BIMA, with ALMA time already scheduled for early 2014.

The **Extra-galactic Astrophysics** group's research and **future strategic directions** are, and will be, concentrated in the following main topics:
Understanding the formation and evolution of star clusters in galactic nuclei and investigating the origin of their scaling relation with the host galaxy properties, together with constraining the growth of supermassive black holes in the same nuclear regions of galaxies. This work, with RCUK fellowship support over part of the REF period (Debattista was an RCUK Fellow 2007-2012 before joining the academic staff, and was subsequently promoted to Reader in 2013), and PDRA funding from STFC, builds on several years of highly-cited observational and theoretical work with multi-mass N-body HPC simulations.
Galactic Archaeology: with simulations of galaxies and their chemical and star-formation histories, and development of stellar population analysis and associated empirical stellar libraries from new observations, together with substantial involvement in international GAMA and Herschel-ATLAS consortia. In particular the future aim is to develop simulations of a late-type galaxy such as the Milky Way, which capture the observed morphological, dynamical and chemical characteristics of these galaxies, to a significantly greater degree than previously achieved anywhere. This sub-group has been at the forefront of the self-consistent chemo-dynamical approach to Galactic Archaeology, with numerous highly-cited papers over the REF reporting period, and has received STFC PDRA funding. The new technique of `chemical tagging', in particular, which was pioneered by Gibson, has led to breakthroughs in our understanding of galaxy evolution. This work uses the UCLAN-HPC facility, as well as the DiRAC-COSMOS machine in Cambridge.
Dust Physics and the formation and evolution of galaxies: including STFC funded PDRA research, uses realistic dust physics for the first time in simulations, calculating dust and PAH emission for a set of forming and evolving galaxies. This work involves substantial involvement in the GAMA and Herschel-ATLAS consortium projects on the part of Popescu and Sansom respectively.
Research into the physics of quasars: and of their astrophysical jets (Cawthorne), together with investigating the association of quasars with their host galaxies and the large-scale structure of the universe as sampled by the largest quasar groups (Clowes). This research uses VLBI observations as well as the Sloan Digital Sky Survey.

The **Solar Physics** group's core research areas and **future strategic directions** are concentrated towards three topical and timely aspects of solar and solar-terrestrial physics:
Understanding magnetic structures in the solar atmosphere: especially the solar corona and self-similarity of such structures, in terms of magnetic sub-structures, heating mechanisms, and time evolution of structures. This research uses the group's magnetic-field modelling, together with data from the EUV Imaging Spectrometer (EIS) on the Hinode satellite, data from the STEREO mission,

and in particular and in future, the NASA Solar Dynamics Observatory (SDO). We host the SDO data hub for the entire UK solar physics community. The group uses SDO's two instruments: Atmospheric Imager Assembly (AIA) and Helio-seismic and Magnetic Imager (HMI) which, respectively, yield full disc images of the sun in wavelength ranges corresponding to temperatures from 50,000K to 10MK; and the distribution of the magnetic field. Our collaboration with NASA Marshall Space Flight Center and the Harvard-Smithsonian Astrophysical Observatory on developing and flying the High resolution Coronal Imager (Hi-C) on a sounding rocket in July 2012, has resulted in the highest ever spatial resolution EUV images of the small-scale magnetic filamentary structure of the solar corona. In 2014/15, this work will be built upon with a re-flight Hi-C and the development of the Marshall Grazing Incidence X-ray Spectrometer (MaGIXS) for the same sounding rocket programme.

Investigating links between coronal dimming and coronal mass ejections, (CMEs): and in particular studying the CME initiation process compared with theoretical models, and assessing whether a CME prediction scheme can be developed based on observations of such dimming. A further aim of this research has been to understand the onset of Earth-directed CMEs. This research uses data from SDO, Hinode and STEREO.

Investigating the role of solar activity on the Earth's environment and on interplanetary space: The group's Space Weather and Solar-Terrestrial Physics research has current PDRA funding from both STFC and the EU. Current research centres around the transport and acceleration of solar energetic particles (SEPs), which are an important Space Weather hazard. This research includes remote diagnosis of CME shock properties, using a test-particle approach as a Space Weather tool on the UCLAN-HPC facility and elsewhere, and investigates the role of turbulence downstream of a CME shock. The key new aspect of this research is to include cross-field transport of SEPs to improve the accuracy of space weather alert forecasting. The software predicting the link between CMEs and the effects on Space Weather at the Earth has recently (July 2013) been incorporated into the EU's COMESEP Space Weather Alert System, and into the European Regional Warning Centre of the International Space Environment Service (ISES). This is expected to produce the most accurate alert forecasts of any such system in future, due to its modelling of cross-field motions of SEPs for the first time.

The **Nano-Physics and Magnetic Materials** group's core research areas and **future strategic directions** are concentrated towards three main areas:

The *Theoretical Nano-Physics subgroup* focuses its research on nano-structured materials. The group is studying the structural and dynamical properties of soft matter at the nano-scale. Its aim is to reveal underlying physical laws of self-assembly and to develop methods for computer-assisted design of nano-structured materials. The group helped found the area of dynamic self-consistent field theory (dSCFT) for block co-polymers, and developed the widely-used MesoDyn software. The group currently has an EPSRC-funded PhD student, and PDRA funding from the Volkswagen Corporation.

The *Experimental Nano-Physics subgroup* works on organic solar cells. Specifically, this subgroup is exploring the properties of Buckminster fullerenes as potential constituents of organic solar cells. Future directions centre around using graphene as a substrate for organic solar cells, with fullerenes as the active agents. This group has been strongly supported by the University, with the recent appointment of a Guild Fellow, Smerdon. The long-term strategic goal of this group is to develop solar cells from materials that could be used on tinted windows, for example. One could foresee a situation where an entire office block's windows, coated in such a material, could provide sufficient power to meet that office block's needs.

Research experience in the *Magnetic Materials subgroup* is founded on studies of dry and wet systems of magnetic structures that are used in the field of magnetic recording media and digital data storage (Mercer). The future strategy for this subgroup is based on another sub-area of investigation which has been initiated more recently: studies of multi-ferroic materials that are one class of the new multi-functional materials that are of considerable interest both scientifically and in terms of their anticipated role in the continuing miniaturisation of technology. This work is in collaboration with the UK's National Physical Laboratory and concentrates on multi-ferroic composites with interest in their magnetic properties, the Magneto-Electric effect, electrical excitation and the interactions between these aspects. This group has also recently published the first theoretical explanation of the Peterson-Kruger effect (Mercer & Bissell 2013) – a known

experimental effect of the linearity observed in the output signal of a magnetic fluid concentration magnetometry technique that has waited more than 30 years for a theoretical explanation.

c. People, including:

i. Staffing strategy and staff development

The UCLan Physics and Astronomy staffing strategy is closely linked, via the current 5-Year Development Plan for Mathematics, Physics and Astronomy described above, to the above-listed core research areas and research strategy. This close linkage applies both within the JHI, and also in developments and aspirations for interdisciplinary inter-school links including, in particular, the University's recently established interdisciplinary Institute of Nanotechnology & Bioengineering (INB).

Physics and Astronomy staff members who retire, have been, and continue to be, replaced by, and new staff positions are filled by, research-active staff, with involvement in international projects and collaborations, and research expertise, which augments the current core areas and planned strategic developments. Of the Category-A staff returned in this submission, the following staff have joined these groups since 2007: Debattista (Galaxies, originally RCUK Fellow), Popescu (Galaxies), Dalla (Solar), Bewsher (Solar), Brown (Solar), Regnier (Solar), Pinna (Nano), Mura (Nano), Ward-Thompson (Stars), Smerdon (Nano) and Stamatellos (Stars).

Extensive career development support is provided for all staff, throughout their employment at UCLAN, including research assistants, early-career researchers, and established academic staff members. This support includes the provision and dynamic development of: induction and tailored mentoring for new staff for both teaching and research, `teaching toolkit' and other training courses as required for new staff undertaking teaching duties, including in particular research assistants; annual appraisals and interim half-year appraisals for all staff, leading to both clear objectives for the following year and also detailed professional development plans, in consultation with the relevant School Executive Team and Human Resources training, and staff development programmes. All JHI staff have either already attained, or are currently working to attain, Fellowship of the Higher Education Academy status.

UCLAN is formally and firmly committed to supporting and implementing the principles of the Concordat to Support the Career Development of Researchers. In 2011, the university gained the EU's HR Excellence in Research Award. Three of the presently submitted staff have benefited from the university's Research Leaders' Development Programme in 2010-12. The University was also awarded `Investors in People' status in 2012. UCLAN also has a comprehensive training programme for research staff and students, recently awarded the Vitae Excellence in Research Training award and associated kite-mark.

The UCLAN Physics and Astronomy staff reporting here include 6 female staff members out of 21 staff in total. This fraction of almost 30% is significantly higher than the median for physics and astronomy departments and groups in the UK, and a similar proportion is reflected in the complement of research assistants and research students within Physics and Astronomy. The University's equality and diversity strategy allows for flexible working arrangements, for example for staff members with child care responsibilities. Sansom, for instance, who has a 90% FTE contract to allow her to work around family commitments, evidences this.

There is also a broad age range of staff, from lecturers to Professors, and in fact the University's career development and promotion strategy is well reflected in that, of the 21 staff returned, 6 are Lecturers, 5 are Senior Lecturers, 4 are Readers, 5 are Professors, and 1 is Associate Dean. The total percentage of staff submitted, of all Physics and Astronomy staff eligible as Category A staff and in post on the census date, is over 80%, indicative of a unit which is highly research-active, and of an environment which is dynamic and creative, intellectually stimulating, and supportive of researchers.

Members of the JHI staff returned in this submission include 10 different nationalities, apart from the UK (Ireland, USA, Canada, France, Italy, Romania, Russia, Malta, the Netherlands and Greece). The associated international culture and interactions within the JHI contribute substantially to a lively scientific and social cross-fertilisation of ideas, backgrounds and experiences. The unit holds weekly seminars given by visiting scholars and researchers from all over the world and every continent, together with presentations by the unit's own staff and research students, along with weekly discussion groups and journal clubs run by each of the groups or sub-groups described in this submission. Apart from visitors on day-visits to deliver

seminars and one/two-day collaborative visits, the JHI typically hosts some 20 longer-term visitors and visiting research students per annum. Consequently, the JHI has a very active, well-established, externally-funded and internally-funded visitor programme, which contributes extensively to the stimulating research culture and international research collaborations.

ii. Research students

An average of three PhD degrees per annum has been awarded in this unit over this reporting period. With the continuing growth of research and staff numbers, with the maturing development of current staff, and increases in research student numbers in these subjects at UCLAN, this average number of completions per annum will increase over the next five years. In 2013 alone, 12 new PhD students have started.

Many past JHI research students have gone on to successful careers in their chosen Physics and Astronomy subjects and positions at many institutions around the world, including Oxford, Cambridge, Imperial, UCL, Harvard-Smithsonian, NASA-Goddard, CalTech, Paris, Florence, Melbourne, Sao Paolo, Helsinki, Johannesburg and elsewhere. The JHI subscribes through its involvement in SALT, to the Stobie-SALT studentships programme funded jointly with the South African National Research Foundation. Two former JHI research students now hold Senior Lectureship posts in South African universities, and another is now the principal Resident Astronomer for SAAO telescopes.

Research students are recruited (via open competition) from UCLAN's undergraduates, from elsewhere in the UK, elsewhere in Europe, and from across the world, with studentships funded by Research Councils, industry and from within the JHI and other UCLAN funding streams. Our students undertake a mandatory induction and training programme, and are supported and monitored by a supervisory team of at least two members of staff, an annual monitoring process, and a more substantial assessment after the first year, involving a detailed report on work done, literature review, internal referee and an interim viva-voce examination. All research students are trained in an intellectually challenging and supportive environment, including via lectures, seminars, discussion groups and journal clubs, and their own presentations, as mentioned above.
UCLAN's Research Student Registry supports the recruitment, induction, progression and examination arrangements for all PGR students. There is a very active Postgraduate Research Society (PROGRESS), which acts as a support group and social group, highlights high quality research and hosts external guest speakers, and helps enhance the all-year-round research experience for PhD students. One of the unit's PhD students is currently President of this Society. UCLAN has a comprehensive training programme for research students, which was recently awarded the Vitae Excellence in Research Training award and kite-mark. All research students are also required to attend an induction day and a compulsory two week Graduate Research Skills programme, at the outset of their study. This is a validated programme, which runs at no cost to the JHI or student, and teaches vital skills, such as: communication and presentation, reflective practice, project management, knowledge transfer, intellectual property rights and academic writing. Part-time students can elect to attend parts of this course, but if they are unable, the University has invested close to £80k through the purchase of the on-line Research Masters Programme from Epigeum.

All students are required to present the results of their work both within UCLAN at least annually, and at international conferences. A significant number of the research students undertake field work abroad. Recent examples include substantial periods of attachment to: Monash University, Melbourne; the South African Astronomical Observatory; and in the USA, linked with the Kepler mission. The research students also benefit from involvement in the unit's teaching and public-outreach work, and in particular with the JHI's leading Distance Learning Astronomy courses which include a unique and innovative BSc (Hons) degree in Astronomy, which involves the JHI's astronomy research in every module.

d. Income, infrastructure and facilities

Grant income from UK Research Councils (direct income, excluding in-kind value of facilities usage) for this unit was approximately £500k per annum during this reporting period. Further direct funding has been won from the EU (solar-terrestrial physics COMESEP, Marie-Curie and NanoSci-E+), the Volkswagen Foundation and other external sources, amounting to a further ~ £200k p.a. In addition, the value of income in kind for overseas international large-telescope observing time,

HPC and other facilities usage allocated by competitive peer review, has amounted to over £300k per annum (REF4c plus non-UK facilities). The JHI currently holds an STFC three-year Consolidated Grant, value £ 700k, for observational and theoretical astronomy and solar-physics research, plus an STFC new appointment award of £380k for Ward-Thompson (who also won alone more than £500k during the REF reporting period whilst at Cardiff University).

The maintenance and development of Physics and Astronomy at UCLAN continues to be very strongly supported by the University, for both research and teaching, and via overall infrastructure. The vast majority of the QR funding allocation for physics and astronomy research at UCLAN has been passed on to the JHI for each year of the REF reporting period. Additional and substantial centrally-funded support has been won via internal competition by Physics and Astronomy staff and students in the form of (a) staff sabbaticals, (b) Research Equipment Development funds, (c) research internships for students and (d) scholarships for non-EU PhD students. JHI staff members who have benefitted from University-funded sabbaticals during this reporting period include Cawthorne, Gibson, Kurtz, Popescu and Zvelindovsky. Finally, this unit's research also greatly benefits from the University's own £400k HPC Facility, and indeed we continue to be the main users of this facility, as well as making extensive use of external HPC facilities including COSMOS (for which UCLAN is a full partner) and time awarded on the EU FP7 DEISA.

UCLAN has invested in two specific additional research projects for the Solar Physics Group. First, it has contributed £150k (for hardware and a system manager) for the Solar Dynamics Observatory data archive hub at UCLAN, which serves the UK solar community and provides a 5-month rolling archive of full-resolution SDO data. Secondly, it has invested £140k in a partnership with NASA to fly the Hi-C instrument on a sounding rocket flight, for which UCLAN has provided detectors and in-flight software. Heritage from this mission will roll forward into the follow-up MaGIXS instrument, for which some of the unit's staff are co-investigators.

e. Collaboration or contribution to the discipline or research base

Major Collaborations

The **Astrophysics and Solar Groups'** extensive major collaborations include contractual and long-term links with over 50 institutes, in countries on every continent. They include the University of Tokyo, the European Southern Observatory, the South African Astronomical Observatory, Monash University, University of Helsinki, INPE Brazil, University of Chile, CEA Saclay, NASA, ESA, Rutgers University, Harvard-Smithsonian CfA, Max Planck Institut fur Kernphsik, University of Michigan, University of Zurich, University of Western Australia, Russian Academy of Sciences, Dartmouth College, IAC Tenerife, Carnegie Observatories, IUCAA Pune India, IAA Bangalore, CAMK Poland, University of Wisconsin-Madison, University of North Carolina, American Museum of Natural History, University of North West South Africa, University of Canterbury New Zealand and Bordeaux Observatory.

The JHI is a full partner in both the RAVE and Herschel-SPIRE consortia, and is a founding partner and shareholder in SALT Foundation Ltd which built and operates the 10-metre Southern African Large Telescope.

The **Nano-Physics and Magnetic Materials Group's** main international collaborations include: RWTH Aachen University and Mainz University, Germany; Leiden University, Netherlands; Tohoku University, Sendai, and the OCTA project, Japan; University of Barcelona, Spain; Norwegian University, Trondheim; University of Massachusetts, USA; Hebrew University of Jerusalem and Technion, Israel; ISCSEM, Caparica, Portugal; Odessa University, Ukraine; and the UCLAN-Shenzhen Centre for Molecular and Soft matter Modelling in Shenzhen (in which the University invested £250k), China; together with Accelrys Ltd. (Cambridge), and the NPL and Daresbury Labs, UK.

Members of the **Solar Physics Group** are heavily involved in community peer review panels and projects and have given several invited talks each year at international conferences. The JHI hosted the STFC Summer School in Solar Physics 2010. Walsh has been chair of the STFC and now UK Space Agency's Solar Physics Post-Launch Support committee. Brown is Deputy Chair of the STFC Astronomy Grants Panel and is a co-I on the UK MHD consortium supercomputer. Bewsher is a member of STEREO/HI and Hinode/EIS instrument teams, an ISSI international team on coronal heating and the UK Solar Physics Council, and is also a Council member of the Institute of Mathematics and its Applications (IMA). Dalla was AstroGrid deputy project scientist and is co-I

on EU FP7 COMESEP consortium and an EU SEPserver advisory board member. She has also been on the SOC for 3 major international conferences. Regnier and Dalla have served on NASA grant review panels. The Solar Group also act as organisers of solar physics national and international meetings and sessions, including STEREO/SOHO and European Geophysical Union meetings.

Astrophysics (Stellar and Extra-Galactic) Group members, including Kurtz, Gibson, Debattista, Popescu and Ward-Thompson, have given over 50 invited and review talks and conference summaries during the reporting period at international conferences, including invited talks at General Assembly of the International Astronomical Union (Beijing 2012) and IAU Symposium 285, invited conference review at CoRoT Symposium (Paris 2009) and at Stellar Pulsation conference (Santa Fe, USA, 2009), invited speaker and SOC member at Fujihara Seminar (Hakone, Japan, 2011), invited speaker at Kepler Science Conference, NASA-Ames (California 2011), Keynote speaker and SEA (Valencia, 2012), invited talks at Kavli Institute Workshop (Seoul, 2012), Gaia Workshop (Heidelberg, 2012), First Structures Universe conference (Buenos Aires, 2011), Vatican Lecture Series (Rome, 2010), Galactic Archaeology meeting (Palm Cove, 2009), Galaxies simulations conference (Leiden, 2008), RAVET workshop (Tenerife, 2008), and at the Universe Explored by Herschel conference (Leiden 2013). Ward-Thompson and Stamatellos co-chaired and co-edited the proceedings of "The Labyrinth of Star Formation" (Crete 2012). Stamatellos has also given 2 invited plenary review talks at major international conferences. Debattista has given 14 invited review talks at international conferences over the reporting period and has been on the SOC for 7. The JHI has organised and run major international conferences during the reporting period: "Hunting for the Dark: the Hidden Side of Galaxy Formation", co-chairs Debattista and Popescu (Malta, 2009); and IAU Symposium 284 "The Spectral Energy Distribution of Galaxies" (Preston, 2011).

Ward-Thompson, Kurtz and Gibson have been elected and served on the Council of the Royal Astronomical Society. Kurtz is Visiting Professor at ARIES, Naini Tal, India. He is a member of the Steering Committee of the Kepler Asteroseismic Science Consortium (KASC). He was member of the Helas FP6 Consortium Board and SONG review board and was previously a consultant to EADS-Astrium for the Eddington space-mission design study. Gibson has been an editor for the Astrophysical Journal during the reporting period. Popescu and Sansom are members of the Herschel-GAMA consortium and Herschel-ATLAS consortium respectively.

Ward-Thompson is external examiner at the Universities of Glasgow and Hertfordshire. He is currently President of the UK Society for Popular Astronomy (SPA). He was a member of the Herschel Time Allocation Committee and is a member of the Herschel SPIRE Consortium, as well as the Herchel HiGal consortium. He is a member of the ALMA UK Oversight Committee and was an ad hoc member of the PPARC PPRP in 2008.

Ward-Thompson has also written a text-book, together with Whitworth (Cardiff), which was published by Cambridge University Press on `An Introduction to Star Formation'. This is a final-year under-graduate, or Masters level, text on the formation of stars, which has received many positive reviews, and which won the award of `*Outstanding Academic Titles of 2012*' by `*Choice'*, an American web source of reviews of academic text-books for those in higher education.

Members of the **Nano-Physics and Magnetic Materials Group** have given several invited international talks and serve on relevant subject and editorial boards. The group has hosted several International Symposia, including the 1st & 2nd `Nano-technology in Health & the Environment' symposia (Shenzhen, 2013 & 2013), `The Physics of Complex Fluids' (Odessa 2012), `Computer Simulations in Soft Matter (Manchester 2011), and `Designing Block Co-Polymers' within the 43rd IUPAC World Congress (Glasgow 2010). Zvelindovsky serves as an International Advisory Board member of *Macromolecular Theory and Simulations (Wiley),* and gave invited talks at the following international conferences: 12th Joint European Thermodynamics Conference (Brescia 2013), 3rd International Conference on Computer & Emerging Technologies (Khairpur 2013), American Chemical Society Spring Meeting (San Diego, 2012), CECAM Workshop (Zaragoza 2012), International Workshop on Self-Assembly (Barcelona, 2011), Dynamics of Complex Fluid-Fluid Interfaces (Leiden, 2011), & International Workshop at Banff IRS for Mathematical Innovation and Discovery, Canada (2010). Zvelindovsky was awarded the Japanese Society for Promotion of Science Invitation Fellowship (2013), the Invited Professorship of Excellence at the Barcelona University (2013), and is a Guest Scholar at Leiden University.