Institution: University of Kent

Unit of Assessment: 9 Physics

a. Overview (outputs named in REF2 are cited as DF1, DF2 etc. just as in the REF2)

The overarching home for Physics at Kent is the School of Physical Sciences (SPS) which has 32 faculty members organised within four research groups: Applied Optics, the **Centre for Astrophysics and Planetary Science (CAPS)**, Forensic Imaging and Functional Materials. The submission here is focussed on **CAPS;** the other research groups all contain physicists but are submitted to other UoAs appropriate to their specific research. **CAPS** has two main sub-groups, each with 3 faculty members: Solar System and Star Formation. The Solar System group studies phenomena from planets, to asteroids and comets, and down to sub-micron interplanetary dust. The Star Formation group studies molecular clouds, protostars and star clusters. CAPS has grown from 4 faculty members in 2008 to 6 now (5 in this submission) plus 16 other researchers (e.g. Post-docs, research students…) and 8 visiting or Honorary staff members.

Kent benefits greatly from membership of the South-East Physics Network (SEPnet - http://www.sepnet.ac.uk/). This has helped coordinate growth in Physics across the region (with support from *hefce* and STFC) and has funded a fellowship and PhD students at Kent. SEPnet has several research-focussed strands including SEPnet-Astro (for astronomy and space science).

b. Research strategy

SPS continues to expand Physics and has continued to recruit new Physics faculty posts since 2008. The School runs a budget surplus each year and invests in refurbishing its buildings and in new facilities. SPS has a rolling 5-year forward-look research strategy in which CAPS is a deliberate target for growth.

Current Status: CAPS research has two main themes: Solar System (Burchell, Lowry & Price) and Star Formation (Froebrich & Smith), with emphasis on areas aligned with STFC objectives.

The Solar System Group focusses on understanding the origins and evolution of the planets, satellites and minor bodies within the Solar System, as well as considering the origin and distribution of complex molecules and life, via space missions (including sample return missions), laboratory impact studies, computational simulation and astronomical observations. The STFC Solar System Advisory Group (whose Roadmap was published Nov 2012) included Lowry as a member. Priority areas in the Roadmap include areas Kent specialises in, such as: impact studies including the leading UK use of light gas guns (Burchell & Price: MJB1-4, MCP1); the formation and evolution of small planetary bodies (Burchell & Lowry: MJB1, SCL1-3) and how they are affected by solar radiation (Lowry); and astrobiology including the origin and distribution of complex organic molecules (Burchell & Price: MCP1). Space missions are also specifically mentioned including NASA's Stardust sample return mission to a comet (Burchell & Price: MJB2-4), Rosetta – an ESA cornerstone cometary mission (Lowry, SCL4), Hayabusa - a Japanese sample return mission to an asteroid (Burchell & Price are analysing samples from this) and ExoMars – an ESA mission to Mars (Burchell & Price now work on Mars related projects).

The Astronomy Advisory Panel Report to STFC (Nov. 2012) includes "Theme 3.2 The formation of stars and planets in the Milky Way and other galaxies". Accordingly, our Star Formation Group focusses on: i) understanding the physics and dynamics of star formation regions as they evolve (Smith & Froebrich: MDS1-2, DF4), ii) uncovering how protostars, proto brown-dwarfs and protoplanets are born and interact with their environment through radiation and mass feedback (Smith & Froebrich: MDS1-4), iii) probing the physics of the interstellar medium, dust and molecular hydrogen (Smith & Froebrich: MDS3-4, DF1-4), and iv) the critical role of hypersonic flow in producing structure on a wide range of scales (Smith: MDS3).

Since 2008 (in-line with our strategy at the last RAE) CAPS as a whole has focused on:

(1) Winning external funding and attracting and developing excellent research staff.

Outcome: CAPS has increased its grants in the period (see section D below).

(2) The development of numerical modelling applied to both Solar System and Star Formation.

Outcome: With SPS & SEPnet support, a 128-core computer cluster was set up at Kent in 2010 for planetary science and astrophysics modelling. A larger cluster, SCIAMA (1000 cores), was acquired by SEPnet-Astro in Portsmouth with external users including CAPS. Modelling has been

carried out on impact events, star formation and dynamics of gas in star forming regions (MDS3).

(3) Engaging with SEPnet partners.

Outcome: Further engagement with SEPnet includes: Lowry's lectureship (initially funded via a SEPnet fellowship) and Smith employed as SEPnet's Director of Research until 2013. Smith created the Grand Challenge PhD programme, now developed into GRADnet - a new initiative to closely coordinate PhD training across the SEPnet members. Lowry and Smith are members of the steering committee for the SEPnet astrophysics research theme (as was Froebrich from 2008-11).

(4) Continuing to secure access to leading external telescope facilities (UK or non-UK funded).

Outcome: Froebrich leads the UWISH2 & UWISH2-E surveys (UKIRT Widefield Infrared Survey for H_2), Lowry is Principal Investigator on a major ESO VLT and NTT observing programme to study YORP effects on asteroids, and details of other key external collaborations are given in Section (e) below.

(And specifically for Solar System studies)

(5) Aiming to recruit new faculty appointments.

Outcome: Two faculty positions were created in Solar System studies (Lowry 2009, Price 2011).

(6) Developing our own internal facilities and grouping research into sub-themes: sample return missions, minor bodies (asteroids and comets), astrobiology and Martian studies.

Outcome: The CAPS two-stage light gas gun was significantly upgraded; it can now fire frozen projectiles at hot or cold targets and has a new large (1.2 m^3) target chamber (2012). The CAPS Scanning Electron Microscope (SEM) and Raman spectrometer were replaced (2011 and 2012 respectively) improving our analysis of impact-altered materials and returned extra-terrestrial dust samples (Burchell & Price: MJB2-4). Burchell & Price have studied catastrophic disruption of rocky or icy bodies (MJB1). On astrobiology, Burchell and Price have studied survival of micro-organisms and fossils in impact events as well as synthesis and destruction of complex organics including the shock synthesis of amino acids from cometary analogue mixtures (MCP1). Price and Burchell now work on Raman studies preparing for *ExoMars* (which will carry a Raman spectrometer to Mars).

(And specifically for Star Formation studies)

(7) Engaging with SEPnet to assist Star Formation activities into Radio Astronomy via LoFAR.

Outcome: Smith is member of the LoFAR-UK management committee and Smith & Froebrich are members of Surveys/LOFAR Galactic Science Team.

Future Aims:

We will continue working on the goals above, closely aligned with the STFC road maps (2012):

- The Solar System group will focus increasingly on Rosetta (Lowry: SCL4) and Mars (Price & Burchell), and proposals for new spacecraft missions (Burchell, Lowry, & Price), along with continuing work on the origin/distribution of complex molecules/life (MCP1), returned samples and impact studies (Price & Burchell: MJB2-4), asteroid/comet observations and dynamics (Lowry: SCL1-4) and asteroid/comet origin and evolution (Burchell and Price: MJB1-4).

- The Star Formation group (Smith & Froebrich) will continue to exploit its collaborations and involvement in the various surveys and missions and SEPnet astro. We will also join new projects involving facilities such as ALMA and the James Webb Space Telescope.

To enable this we will:

- Continue to build collaborations around international space missions for Solar System (Rosetta, ExoMars and proposed new missions) and Star Formation (Spitzer Deep Glimpse, Herschel Hi-Gal etc.) research and use ground facilities for Star Formation work (LoFAR, ALMA predictions, UWISH2 Surveys, etc.).

- Continue to run our own laboratory facilities to exploit areas of expertise (e.g. Solar System: impact and material studies via light gas gun experiments, SEM and Raman spectroscopy and computer simulation; Star Formation: computer simulation).

- Continue to secure access to leading external telescope facilities, either UK or non-UK funded.

- Aim to widen the sources of income beyond STFC.

c. People, including:

i. Staffing strategy and staff development

During 2008-2013, 2 new faculty posts were appointed strategically to expand Solar System

studies, both lecturers have made such an impact they have already been promoted. Over the next REF period we aim to make further new appointments in-line with STFC priority topics. We both develop our own staff (e.g. Price was appointed internally, 2011, promoted to Senior Lecturer, 2013), and hire externally (Lowry was from NASA's Jet Propulsion Laboratory/CalTech, California, appointed 2009, promoted Senior Lecturer 2011). In line with our strategy of making use of both internal and external resources: Price is an expert in light gas gun studies and skilled in SEM and Raman spectroscopy, he also specialises in computational studies and runs our in-house computer cluster, and Lowry leads observing programmes which make use of external telescope facilities.

All PDRA posts are advertised externally and internationally (one PDRA was hired from a previous position in California at Lawrence Livermore National Laboratory). PDRAs are supported to attend international conferences each year and relevant workshops.

New lecturers are required to undertake a Postgraduate Certificate in Higher Education (including research planning, research management and PG supervision) and relevant parts of this are available to PDRAs (required if they volunteer to lecture). New lecturers are mentored by an experienced staff member. There is a 3-year probation period with reduced workloads (2/3rd reduction in year 1 and 1/3rd in year 2) and which includes a probation plan (with research goals) with annual progression monitoring. After probation, they agree a 5-year plan with their Head of School and the Dean. There is an annual Promotion round and staff can self-nominate: there is no need to complete probation before applying (c.f. Lowry and Price). Study leave is at the rate of 1 term every 6 terms. Annual appraisals are required for staff including PDRAs and technical staff. Training is provided for a wide range of transferable skills; all academics and PDRAs are required to attend at least one such activity a year.

CAPS has weekly meetings during term, which include presentations from a mixture of internal and external speakers. External speakers are also invited to give School seminars. External visitors (including from overseas) make research visits to CAPS for periods from 1 day to several weeks each year. In the last 12 months (which was a typical period) these have included visitors from the UK (Natural History Museum, Leeds, Liverpool, Cardiff, Herts, Sussex, Exeter, Oxford, UCL and MSSL) and overseas (Max Planck Institute Katlenburg-Lindau, ESA-ESTEC, NASA, US Navy Research Lab, US Navy Academy, Mississippi State, Virg. Tech., Japanese Space Agency).

The University of Kent is fully engaged with the Concordat to support researcher development and the key principles are embedded in our approach to staff. As part of this the University attained the European Commission's HR Excellence in Research Award in 2013.

All senior academic and administrative staff attend equalities and diversity training. The Faculty has applied for an Athena SWAN Bronze award for all science Schools and SPS has its own Athena SWAN committee which is preparing submissions for Juno and for a Silver Athena SWAN award. SPS has female representation on all PhD scholarship award committees and all PDRA and faculty appointment panels. SPS has reviewed its seminar programme to make sure female speakers are included. SPS has a comprehensive workload allocation model, which has been checked for un-intentional bias in both the tasks listed in the workload and in allocation of key managerial roles. The % of female faculty members in SPS is growing and is now 25%. SEPnet-2 (2013-2018) has a whole strand devoted to supporting more inclusivity in the members including UG and PG recruitment as well as supporting Athena SWAN/Juno activities.

Organisation of research:

At School level a Research Committee oversees performance in line with University, Faculty, School and research group Research Plans. CAPS prepares written reports three times per year for the School and Faculty Research Committees plus an Annual Report. Each staff member has a regularly updated full research CV and meets annually with the SPS Director of Research and Head of School to discuss this, with an emphasis on future research plans. The Faculty of Science helps with seed-corn money for new projects (with a £30k annual fund, rising to £50k in 2013/14). In the last 2 years, 5 seed-corn grants have been awarded to CAPS members (including one to a PDRA to help her develop her research independence). The pVC Research also has a research investment fund and supported **Lowry** by buying out part of his teaching in 2012/13. The University has a Research Services office, which supports grant preparation and submission and has recently overseen the introduction of policies on Open Access and the Research Concordat.

ii. Research students

Recruitment. Strong recruitment procedures are in place for PhD studentships which are

advertised externally. All students possess a research MSc or a 4-year undergraduate degree (MPhys, MSci). Student recruitment is via a mixed gender interview panel. Overseas students are subject to strict scrutiny of language qualifications and reference letters. SEPnet membership helps broaden our recruitment pool and to attract highly motivated students.

Training and support. Research students are managed by the School's Executive Board of Graduate Studies, which includes student representatives. Each student is assigned a supervisory panel in addition to the primary supervisor (allowing junior staff members of staff to gain experience and broadening the links between members). In addition, SEPnet funded students have joint supervisors from another SEPnet institution.

The University Graduate School implements postgraduate strategy and coordinates the Researcher Development Programme for postgraduate researchers. The Programme helps equip students (and postdoctoral researchers) with a full range of skills, improving their effectiveness as researchers and ensuring that they are not only highly qualified, but also employable in a variety of careers. The University Code of Practice provides a comprehensive governance structure for the regular monitoring, review and development of postgraduate training. This is mapped to the four areas outlined in the national Researcher Development Framework and includes formal research training, career development elements and structured supervision by the supervisory team.

All new PhD researchers attend a workshop which introduces them to the University's Researcher Development Assessment (RDA). Via the RDA, all students consider their existing portfolio of skills, as well as the skills that they hope to acquire. As part of this, a full range of workshops is on offer. These include writing and presentation skills, research methods, scientific programming, qualitative methods training, viva training, time management, leadership, knowledge exchange, entrepreneurial resources, publishing, and career planning. This helps PhD students to complete their research and thesis writing using the most effective means.

Communication skills. All staff and students are encouraged to make academic visits, receive academic visitors, participate in conferences and workshops and present seminars. Each student attends weekly CAPS meetings, gives at least one talk per year in the CAPS seminar series and must attend at least 6 SPS colloquia in their 1st year. Research students must attend the "Annual SPS Postgraduate Colloquium" and present a poster (first year) and talk (second year). SEPnet-Astro also provides workshops and video-conferenced lectures and seminars. Research students and staff have had increased opportunity to participate in Public Engagement through SEPnet funding for Outreach. CAPS PhD students are supported to attend relevant Royal Astronomical Society meetings in London and to attend and present work at major international conferences.

Progress Monitoring. The University operates a clear progression monitoring and supervisory system for research students. Supervisors meet with their PhD students regularly (usually weekly) and a formal written supervisory record is maintained on-line. Personal Development Plans (PDPs) are required to be kept by each student including a points-based system of training in which points have to be acquired each year in order to progress. For the 'Knowledge Element' a full lecture Module at M-level must be passed, or the equivalent in coursework achieved. Student progress is reviewed at key Milestones during the course of the research. Annual progression reviews are held for each student and progression has to be agreed with the School Director of Graduate Studies

SEPnet helps expand on this by providing an environment for networking and additional facilities. SEPnet video lectures/seminars are open to all CAPS researchers and students. SEPnet also provides a full-time Employer Liaison Officer who coordinates Knowledge Exchange and internships across the region. The SEPnet-2 programme, 2013-2018, incorporates a Kent Employability Officer who will help provide a rigorous postgraduate employability programme including careers and placement services and internships with employers.

GRADNet. The new GRADnet (2013 onwards) is a SEPnet-2 programme aimed at sharing resources regionally, to develop a programme of academic, leadership and transferable skills for physics PhD students. Its central director will forge links between PhD training programmes in the members' institutes. Industrial placements will be a key part of this.

d. Income, infrastructure and facilities

INVESTMENT, SPECIALIST INFRASTRUCTURE AND FACILITIES.

Since 2008 the University has invested ≈£5M in SPS in building refurbishment and new, research level, laboratory equipment, including a scanning electron microscope, a 128-core high

performance computer cluster and a micro-Raman spectrometer (with four lasers) – all operated by CAPS. SPS has also bought a 400 MHz NMR spectrometer, X-ray fluorescent spectrometer, powder X-ray diffractometer, FT-IR spectrometer, SEC/GPC system, BET nitrogen adsorption and ball-milling instruments to which CAPS members have full access. A pool of 11 experimental officers/technicians supports research in SPS, one of whom works in the Impact Laboratory. Centrally, the University has a well-stocked library with a specialist science librarian and extensive electronic access to major journals relevant to CAPS research.

The initial SEPnet consortium of seven university physics departments (Kent, Portsmouth, QMUL, RHUL, Southampton, Surrey & Sussex) has encouraged and sustained growth in Physics across all of its the members. SEPnet was awarded £12.5M from HEFCE Strategic Development Fund for 2008-13 and as part of this provided a boost of ≈£3M in total to Astrophysics. This included appointing lecturers (including **Lowry**), PhD students, LoFAR Telescope subscriptions, joint computing facilities and technicians. The expanded SEPnet-2 consortium (2013-18) now has nine members (the original 7 plus the Open University and Hertfordshire) and was awarded £2.75M from the HEFCE Catalyst Fund. This will be invested in an innovative Graduate School (GRADnet, see above) and enhanced Outreach and Employability programmes, with the consortia members contributing another £10M in total.

University funds have supported four CAPS PhD studentships in the last four years (in addition to STFC funded PhDs). The University also contributed matching funds for the 128-core computer cluster (SGI Altix ICE, total cost £150K), the establishment of an MPhys UNIX Computational Astrophysics Laboratory (a suite of 10 UNIX PCs for final year UG research projects) and Astro, the Centre's web, e-mail and license server. CAPS has access to SEPnet's SCIAMA high performance cluster located in Portsmouth. In addition, the SEPnet physics kit list published on-line allows all members access to regional resources across the network.

Use of major facilities not STFC supported or not included in Ref-4c data.
PI: Froebrich, UKIRT: U13A/01 (Narrow-Band imaging survey of the inner Galactic Plane) 18 nights (£307K; awarded Dec. 2012).
PI: Lowry, Palomar Observatory, 5m Hale Telescope(LFC) 140 hrs in 6 proposals, 2008-2009.
PI: Price, 21 days of competitive time on the Heidelberg Dust Accelerator via the Europlanet-TNA funding initiative in support of the NASA *Stardust* mission.
Co-I: Burchell: Diamond beamline I18, experiment number 1833, 5 days (Determining the Oxidation state and mineralogy of Comet Wild2).
Co-I: Froebrich: - UKIRT: 36hrs for U/08A/10 (DR21 High mass YSO Spectroscopy), 14hrs for U/08B/14 (Completing the TAP Survey), 4hrs for U/SERV/1862 (A survey for protostellar H_2 jets in Orion B), 3hrs DDT time U/12B/D6 (H2 imaging of the high amplitude UKIDSSGPS variables), and 220hrs, Korean time (a [FeII] survey of the inner Galactic Plane).
- JCMT: 24hrs for M09BU20 (CO Outflows in Orion).
- Spitzer Space Telescope: 1350hrs for #80074, Deep GLIMPSE (**Smith** is CoI as well)
- Gemini: NIFS, 4.7hrs for GN-2013B-Q-47
- Liverpool Telescope: 20hrs for XJL13A08, 16hrs for PL13B14 and 43hrs for JL13B01
Co-I: Lowry:
-VLT 81hrs; NTT 415hrs; Palomar 210hrs; at Palomar, Liverpool 18hrs; INT 40hrs; TNG 30hrs.
Co-I: Smith: Herschel: OT1 (344hrs of priority 1 for the Hi-GAL project) and OT2 (257.8 hrs of priority 1 for the Hi-GAL2pi project).
- LoFAR: 36hrs for LC0_032 (High Mass stars).

Local Faciltiies: the Impact Lab with its Light Gas Gun is a major facility run at Kent. It regularly attracts visitors from across the world. The Impact Lab has external collaborations with many UK groups (e.g. Aberdeen, Glasgow, Imperial, Leeds, Leicester, Manchester and the Natural History Museum) and internationally (e.g. ESA, NASA, JAXA, the *Stardust* consortium, Mississippi State, Virginia Tech, US Navy Research Lab and US Naval Academy amongst others).

RESEARCH FUNDING PORTFOLIO
In the Solar System group, three STFC standard grants were held in 2008-2013, by **Burchell** (£543k, 2008-11 and £440k, 2011-14) and **Lowry** (£315k, 2010-13). A STFC consolidated grant has now been awarded for solar system work by **Burchell** & **Price** (£406k, 2013-2016). **Price** also holds a STFC/Aurora grant (£100K, 2012 – 2015). CAPS held an STFC Visitor Support Grant for

Theoretical Astrophysics (£10K) and a Starlink Manager Grant was held until 2009. IT support is now provided from SEPnet-Astro to maintain the research webpages. A PATT rolling grant for the astronomers was held until September 2008, now replaced by individual funding requests. CAPS has also been awarded research grants from SEPnet, the University of Kent and the Leverhulme Trust. We also participate in an FP7 IRSIS programme coordinated by Porto astronomers.

Industrial links by CAPS include an award of £115k under the Knowledge Transfer Programme (applying star formation modelling to design of smoke/fire detectors). There have been contracts to the Impact Laboratory which include ballistic impact work from the Netherlands Forensic Science Service (£11k, 2012-13) and NASA ($12,500, 2008-09) to test impact sensors. The University Enterprise Unit also helps arrange meetings with potential partners, e.g. AWE, DSTL and Qinetiq.

The University's Research Services provides regular notifications of funding opportunities and offers support with research grants preparation. In addition: "Grant Factory" workshops are led by academics with experience in obtaining grants; experienced members of the School help junior staff in developing grant proposals; and the University has a pre-submission Peer Review system.

In future, as well as the STFC consolidated grant, applications will be made to a range of funders (including ERC and Leverhulme) as well as pursuing further industrial contracts and KTPs. Applications for use of central facilities (e.g. telescope time, Diamond) will also be pursued.

e. Collaboration and contribution to the discipline or research base

RESEARCH COLLABORATIONS

Collaborations by the Star Formation group include:

- Smith & Froebrich belong to the UWISH2+UWISH2-E, UWIFe [FeII], UKIRT Hemisphere, Vista VVV, and UKIDSS Galactic Plane surveys

- Smith & Froebrich belong to the Herschel Hi-Gal, Spitzer DEEP GLIMPSE consortia/missions as well as LoFAR(UK) through SEPnet. Kent is also a member of the consortium of UK universities contributing to the UKIRT extension fund.

- Following 6 years of European INTAS funding led by Smith, the Cygnus-Helix Consortium (including Froebrich & Smith and astronomers from Armenia, Canada, Germany, Japan, Russia, and the USA) continues to investigate this previously unexplored Star Formation Region.

- Smith & Froebrich are members of a working group for young star studies with Gaia.

- Smith & Froebrich were Co-I's of the (EU funded) Marie-Curie exchange project between Portugal, India and Kent (PIRSES-GA-2008-230843).

Collaborations by the Solar System Group include:

- NASA's *Stardust* mission (which returned cometary and interstellar dust samples to the Earth). Burchell has been a member since 1996, and Price joined in 2008. Price and Burchell have provided essential calibration work which enabled the measurement of the size distribution of dust from comet 81P/Wild-2 (MJB3) and contributed to sample analyses for this project, e.g. the first calibrated measure of the pre-solar nebula content of a comet (MJB4) and comparison of cometary and interplanetary dust (MJB2) and dust grain size and sorting in the solar nebula.

- Hayabusa sample analysis: In 2010 the Japanese spacecraft Hayabusa returned samples of the Itokawa asteroid to Earth. The UK Hayabusa consortium (led by the Open University and including Price & Burchell) has been co-ordinating the UK's effort on analyzing the returned samples, and has successfully acquired two such grains. Kent is the first group in the sample analysis chain and undertook Raman measurements of the grains using our new Raman spectrometer.

- In 2008 Burchell joined a US team (NASA, US Naval Research Lab, US Naval Academy, Virg. Tech. and Kent) developing new impact sensors to help monitor dust fluxes in space.

- Lowry is Principal Investigator on an international observing programme to study YORP effects on asteroids via ESO VLT and NTT (with one of the largest awards of telescope time on ESO facilities under the Large Programme scheme which is designed to make major impacts on the respective research field). Lowry is a member of the science team for the optical-camera instrument (OSIRIS) on ESA's Cornerstone Rosetta spacecraft mission. Lowry is a leading collaborator on the SEPPCoN programme, a large international observing programme to study the icy cores of comets, relevant to solar system formation. Lowry also provides extensive observational support to a range of spacecraft missions to solar system small bodies (Deep Impact, EPOXI, Stardust-Next).

INFLUENCE ON DISCIPLINE

Committees/external Positions/Awards

Burchell: Member of the "STFC Astronomy Grants: Planetary Studies Panel" 2013-15, Aurora Fellowship Panel member (2009), Honorary Professor at Imperial College (2010 - 2013), two NASA Group Achievement Awards for: Research and Technological Development (2009), Stardust Interstellar Preliminary Examination (2013), member of Barringer Medal Committee of the Meteoritical Society 2013-2016, Chair of the Astrobiology Society of Britain (2006-10) and a Committee member from 2002-2012.

Froebrich: NASA Peer Review Panel 2011, UKIRT Time Allocation Committee 2007 - 2010, SEPnet-Astro Steering Committee 2008 - 2011, Member of VVV management team 2010-present.

Lowry: STFC Solar System Advisory Panel member (2012 - 2014), panel member of NASA Discovery Programme Review which selected the 2010 spacecraft mission proposal (2010/2011), SEPnet-Astro Management Comm. (2010-present), STFC Telescope Allocation Committee for Liverpool 2m Telescope (2013-2015), external reviewer 8m Subaru Telescope (2013 round).

Price: NASA-JSC Group Achievement Award for Stardust Interstellar Preliminary Examination (2013), Member of Astrobiology Society of Britain main Committee (2013 onwards).

Smith: NASA Peer Review Panel 2011, STFC e-VAL Panel 2011 - 12, L'Oreal UNESCO Fellowships Reader (2012, 2013), SEPnet Director of Research (2011 - 2013), SEPnet-Astro Chair (2009 - 2011) and RAS group award winner for UKIDSS (2012). Member, International Astronomical Union since 1997, divisions C (Education, Outreach and Heritage), F (Planetary Systems and Bioastronomy) and H (Interstellar Matter and Local Universe)

-External examiner:

Burchell: PhD examiner at Imperial College (2008, 2012), Univ. Tel Aviv (2010), Aberdeen (2010)

Froebrich: PhD examiner at Univ. Tel Aviv (2013), MSc examiner at Univ. of Herts. (2012/13)

Lowry: PhD examiner Open University (2012). MSc examiner for planetary science for UCL (2011)

-Journal Editorial Board/Books

Burchell: guest editor of two issues of International Journal of Astrobiology (2009 and 2010) and member of the Editorial Board of the International Journal of Astrobiology since 2012.

Lowry: Co-author on: 'The Solar System Beyond Neptune', University of Arizona Press (2008) which won a group PROSE award in 2009.

Smith: Book (sole author): "Astrophysical Jets & Beams" in CUP Astrophysics Series, 2012. Editor-in-Chief, International Journal of Astronomy & Astrophysics. Editorial Boards: Astronomy Studies Development, Journal of Astrophysics Research, Journal of Astrobiology & Outreach, International Journal of Advanced Astronomy

-Conference/workshop organisation/chairs (excludes numerous invited lectures)

Burchell: organized 3 Royal Astronomical Society meetings, been part of 4 international meeting committees, session chair at two international meetings and organised the 2nd STFC Astrobiology PhD Summer School held at Kent in 2009.

Lowry: National Astronomy Meeting 2012+2013 (Session Co-organiser, Session Chair). Co-organiser of a Royal Astronomical Society Meeting (2013). Co-organiser for Royal Society Summer Science Exhibition exhibit "Ice Worlds: The Solid Bodies of the Outer Solar System" (2013).

Burchell, Lowry & Price: Are the joint organisers of an RAS Meeting entitled: "Bridging the Gap: Comets after Stardust and Before Rosetta" to be held in the year 2013/14.

Smith: Chair, Science Organising Committee, of the 2012 Grand Challenge Conference, Southampton; Member of SOC, International Workshop at TIFR, India, 2009 & UK NAM 2014. Member SOC, UK NAM 2014

INTERDISCIPLINARY RESEARCH

Price & **Burchell's** research straddles many fields. Recent work includes the survival of yeast spores and phytoplankton during hypervelocity impact in collaboration with biologists. **Price** (PI, with a biologist Co-I) has submitted a grant application to Leverhulme to study the effects of impact shock on DNA and impact induced mutagenesis. Additionally, **Price & Burchell** have collaborators in the Earth Science, mineralogy, spacecraft systems engineering and chemistry communities.