SCOTTISH UNIVERSITIES PHYSICS ALLIANCE
PHASE II

Annual Report to the
Scottish Funding Council

For the period 1 August 2012 to 31 July 2013

Including:

Final Report PEER: Ref H11001 and Postdoctoral Early Career Researcher Exchanges Ref: H11002

Interim Report PEER: Ref H11003 and Postdoctoral Early Career Researcher Exchanges Ref: H11004

Interim Report Use of Restored Funding – SUPA Industrial Placements Scheme - Ref: HR09008

Prof James Hough FRS FRSE,
Chief Executive Officer

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PART 1

SUPA PHASE II – Report to the Scottish Funding Council for the period 1st August 2012 until 31st July 2013

PART 1

EXECUTIVE SUMMARY

This has been another highly successful year for SUPA as demonstrated in many ways:

- the most outstanding being the award to Peter Higgs of the Nobel Prize in Physics (even if it is slightly outside the reporting period).
- the funding by the research councils, the SFC and the Universities of the International Max Planck Partnership.
- SUPA KT exceeding all KPIs for commercial engagement.
- grant income continuing to remain healthy over all areas in a difficult funding environment, grant income during reporting year is £92 M and the energy theme is now winning significant income.
- graduate student numbers also remaining healthy as are applications for SUPA Prize studentships.
- the winning of 5 European Research Council Awards (3 Starter, 1 consolidated and 1 Advanced) in the period with more in the pipeline.
- the award of 24 prestigious fellowships this year.
- the award of 9 prestigious prizes.
- the support of 17 patent applications and the award of 3 patents in the period.
- the completion of appointments of all SUPA funded positions.
- the expansion of SUPA KT to take over the running of the Scottish Opto-electronics Association.
- the development of a sustainability plan.

A snapshot of the current status of SUPA is shown in the table below:

• Total Academic Staff	267
• Total Research Staff	349
• Total Graduate Students	534
• Collaborative Grant Income	£174M
• Non Collaborative Grant Income	£80M
• Number of Prestigious Fellows	74 (approximately)
• Number of ERC grants	22

For further information including the metadata for this report see:
http://www.supa.ac.uk/reports/2013

1 GENERAL

1.1 There has been major progress within all areas of SUPA II over the reporting period. Firstly to address our key performance indicators:

Publication Rates

Year	2010-2011	2011-2012	2012-2013
Number of Publications	1100	1300	1378

Citation rate per calendar year

Year of Publication	**2010**	**2011**	**2012**	**2013**
Citation rate in 2010	1.9			
Citation rate in 2011	5.1	2.4		
Citation rate in 2012	6.3	5.7	2.9	
Citation rate in 2013	4.1	4.1	4.8	1.2

Publication rates compare very favourably with the numbers for physical science for Scotland in the Evidence Report 2010:

http://www.scotland.gov.uk/Resource/Doc/981/0093770.pdf.

Total SUPA publications in 2012 are 38% of the total number of physical science papers published in Scotland in 2008, (NB physical science includes Chemistry and some areas of Physical Engineering). Citation rates are significantly better than the average for Physical Science in Scotland in 2008. An updated Evidence report is currently being commissioned and so we believe that a clearer direct comparison will be possible next year.

Grant income

Current Annual Income since start of SUPA II

Year	**2010-2011**	**2011-2012**	**2012-2013**
Collaborative Grant Income	**not available**	161M	174M
Non Collaborative Grant Income	122M	50M	80M

Much fuller information on grant source, new and cumulative grant income, including completed grants, is given in the grant information Annex B.

Research Staff, Post Doc and Support Numbers

Total Personnel Numbers:

Year	**2010-2011**	**2011-2012**	**2012-2013**
Chairs & Professors	73	96	107
Other Academic Staff	116	139	160
Fellows, Post Docs & Research Assts	264	327	349
Total	**453**	**562**	**616**

2012-2013 total personnel numbers include accepted offers (academics)

Prestigious Fellows:
2010-2011 personnel numbers includes approximately 24
2011-2012 personnel numbers includes approximately 50
2012-2013 personnel numbers includes approximately 74

Total SUPA Personnel Numbers

Year	2010-2011	2011-2012	2012-2013
Chairs	4	6	8
Fellowships	8	15	17
Readers	4	5	5
Lecturers	4	7	14
Research Assistants	7	7	8
Total	**27**	**40**	**51**

Almost all appointments have been made; there is still one Advanced Fellow to appoint at Strathclyde.

Research Student Numbers

Year	2010-2011	2011-2012	2012-2013
Total number of Research Students	522	517	534
Number of completed applications for SUPA Prize Studentships	320	329	291
Number of Prize Studentships Awarded	16	10	4

Graduate student numbers and Prize Studentship applications are remaining essentially constant (within statistical error). However the number of Prize Studentships awarded decreased significantly in 2012/13. This was a conscious decision of the SUPA Executive following the cut to SFC funding in 2011/12 and the resulting uncertainty as to whether the cut would continue into future years. While not in the reporting period, it should be mentioned that the number of SUPA Prize Studentships has increased significantly for 2013/14.

Diversity Initiatives

Univerity	Athena Swan	Juno
Aberdeen	Bronze (institutional)	Supporter
Dundee	Application 2013	Supporter
Edinburgh	Bronze (institutional)	*Practitioner
Glasgow	Silver	Champion
Heriot-Watt	Bronze (institutional)	Supporter
St Andrews	Bronze (institutional)	Practitioner
Strathclyde	Bronze (institutional)	Application 2013
UWS	Application 2013	Application 2013

*Champion status awarded January 2014

KT interactions

Year	Dec 09-2010	2010-2011	2011-2012	2012-2013
Number of support projects to Scottish SMEs under SEEKEIT/ERDF grant (SUPA Start)	11 + 1 SUPA Start Plus	13	8	5
Number of Industrial Studentships placed under INSPIRE	9	5	**No further funds**	**No further funds**
Number of INSPIRE Placements	0	0	5	2
Number of engagements with Scottish SMEs through PEER	n/a	n/a	n/a	7
Number of STFC KE schemes awarded across SUPA partners	2	2	3	4
Number of Industrial Placements from Restoration	n/a	n/a	n/a	5

All SUPA KT KPIs bar one have been met or exceeded. Key examples include: 38 SMEs have been supported under SEEKIT/ERDF (KPI = 35): resulting R&D spend in partner companies = approximately £2M in 2 years (KPI = £1.2M in 5 years); 14 industry studentships have been placed under INSPIRE (KPI = 12); SUPA KT staffing to date 21 man years (KPI = 9). It has further provided about £1.4M of funding directly into the SUPA departments (excluding SUPA staff salaries) and has made a significant contribution to securing at least a further £1.26M of external grants to the SUPA partners. For European funding SUPA KT is building expertise and providing resource to new projects and has supported successful FP7 bids.

1.2 Consortium Progress towards Objectives/Recommendations as outlined in the Strategy document of 2010

While there were no milestones set in the SUPA II definitive document there were a set of objectives/recommendations outlined in the Strategy document of 2010 and these are outlined and progress commented upon below:

1 Effects of Research Council Funding in The Programme Areas of Astronomy, Particle Physics, Nuclear And Plasma Physics – Strategy Document December 2010: Section 3.1 The Science Case (recommendations from the Advisory Committee)

Funding in these areas has remained relatively constant and at reasonable level. However, overall in SUPA as can be seen from the funding Annex B the fraction of European funding is becoming more significant.

2 Energy Theme: to be Refined and Scotland's Low Carbon Strategy to be Built into the Programme

Theme is growing very well, with three new academic appointments in areas relevant to solar and nuclear power. In particular this year Ifor Samuel at St Andrews has won an ERC Advanced Grant in organic solar cells and with colleagues has raised major funding in related areas from EPSRC.

3 **PaLS Programme: Should Address Developing Substantive Academic Involvement and Collaborations with Clinical Medical Community, an Integrated Approach to Biological Challenges, Appointing Young Emerging Stars and making use of National Facilities Such as Diamond**

Fifteen new academic/fellowship appointments, many with no SUPA contribution to funding, relevant to this field have been made in this year, and two new collaborative programs directly involving the clinical medical community have commenced, one led by Heriot-Watt and two by UWS.

4 **Astronomy Programme: Recommended that a more Focussed Programme be Developed, Concentrating upon Areas of Existing Excellence**

Seven new academic/fellowship appointments this year, many with no SUPA contribution to funding, have been made in the targeted areas of excellence, all of which are continuing to flourish: Extrasolar Planets, Gravitational Waves, Galaxies, and Solar physics

1.3 Conditions of Grant, Annex C

In addition, as per the original conditions of the grant award letter, Annex C, information is given below as to progress made towards these conditions:

Table 1.3.1 Main Purpose of Grant

Point	Main Purpose of Grant, Grant Conditions Annex C, point 30	Progress made towards Grant Conditions, Annex C
30(a)	**Enhancement of the partnership**: Universities of Aberdeen and Dundee to join SUPA II.	The universities of Aberdeen and Dundee joined SUPA II with effect from 1 December 2009.
(b)	**SUPA Central infrastructure** to include the appointment of a CEO, Director of Graduate School and 3 administrative support staff.	Prof James Hough, was appointed as CEO, with effect from 1st May 2011. Avril Manners has continued from SUPA I as Graduate School Director. After some initial staff changes, an Administrator and two secretarial staff are currently in place.
(c)	**Appointments** to include: 6 Chairs, 20 Adv Fellows, 3 Fellows, 12 Lecturers, 4 Professors, 4 Readers and 6 Research Assistants	Stretching of the SUPA II budget over seven years together with the cut to SFC funding in 2011-2012 has resulted in a modified profile which includes: 8 Chairs/ Professors, 5 Readers, 14 Lecturers, 18 Advanced Fellows, and 8 Research Assistants. All but one of the positions have been filled or committed to date.
(d)	Establishment of a **Knowledge Transfer Directorate** to co-ordinate and boost the economic impact of SUPA.	A Knowledge Transfer Director, Dr Roy Clarke, was appointed in September 2010 and is currently assisted by three other staff at Strathclyde, Glasgow and Heriot-Watt.
(e)	Enhancement of the **PG training** offered by SUPA and expansion of the Prize Studentship Scheme to 15 studentships per annum from 2010 onwards.	The PG training offered by SUPA has continued to be enhanced and further information is given on this later in this report. Four new students were started in the year 2012/13. This smaller number was a strategic choice based on the SFC funding cut imposed for 2011/12 and ongoing uncertainty.

(f)	Enhancement of the structure of SUPA II to create Strategic Research Initiatives which will cross the research theme boundaries.	The current operating structure is encouraging initiatives particularly across the Photonics, Life Sciences, Energy and Nuclear boundaries.
(g)	The addition of a further Strategic Research Initiative on Physics and Life Sciences, including greater multi-disciplinary working with the Scottish Universities Life Sciences Alliance (SULSA).	The Physics and Life Sciences theme (PaLS) that was initiated in 2009 has developed significantly and there are strong interactions with members of SULSA in research and graduate training, with joint courses being offered. A senior member of SULSA currently sits on the SUPA Board of Directors.
(h)	An expansion of the International Visitor Programme.	During the reporting period a total of seven Distinguished International Visitors were funded by SUPA. Further expansion has not been possible at this stage due to the overall budget for the Graduate School being decreased to provide support for KT activities. However a further 91 visitors were funded by the Physics Schools themselves.

Table 1.3.2 Review of Strategic Vision

Point	**Grant Conditions, Annex C, points 31 and 32**	**Progress made towards Grant Conditions, Annex C**
31	Review of Strategic Vision within six months of grant start date, Grant Conditions Annex C, point 31.	Review of Strategic Vision: See Review of Strategic Vision already submitted in December 2010.
32	SUPA Advisory Committee to be fully engaged.	International Advisory panel is now fully engaged with the chair Prof Malcolm Longair taking a lively interest in all areas of operation.

Table 1.3.3 Governance Proposals

Point	**Governance Review: Grant Conditions Annex C, point 33.**	**Progress towards proposals made by Governance Review Panel in 2009**
33 (a)	SUPA to introduce a **Board of Directors** with membership from each Institution at Vice-Principal level.	A Board of Directors has been set up, and currently comprises: Prof John Chapman, **University of Glasgow**; Prof Tim Newman, **University of Dundee**; Prof Alan Miller, **Heriot-Watt University;** Prof Chris Hawkesworth, **University of St Andrews**; Prof Roddy Williamson, **University of West of Scotland**; Prof David Littlejohn, **University of Strathclyde**; Prof Celso Grebogi, **University of Aberdeen**; Prof Richard Kenway, **University of Edinburgh (Chair).**

(b)	**SUPA Executive Committee** to be chaired by the new CEO.	Prof. James Hough, CEO, has been formally chairing the SUPA EC Meetings, since his appointment in May 2011.
(c)	The **International Advisory Committee** should continue to have an important role in advising SUPA.	CEO is in regular contact with the Chair of the Advisory Committee which meets annually.
(d) 1)	**Graduate Training**	Graduate Training and Support are firmly embedded in the ethos of SUPA and continue to develop and be a success.
(d) 2)	**Knowledge Transfer**	The Knowledge Transfer programme is also firmly embedded and delivering on many fronts.
(d) 3)	**Outreach and Public Engagement Co-ordination Group**	An Outreach Group is being formed, with representatives from each University, chaired by Prof Martin Hendry. The Outreach Group reports back to the Graduate School Committee. Details are given later Section 3.6.

Table 1.3.4 Monitoring, Evaluation and Reporting

Point	Governance Review: Grant Conditions Annex C, points 34,38,39,41.	Monitoring, Evaluation and Reporting
34	SFC to be represented on the International Advisory Board.	The Director of the Research and Innovation Group, Prof Paul Hagan, attends the International Advisory Board.
38	SUPA's Key Performance Indicators	See earlier section
39	EU Framework Programmes - maximising opportunities.	There is significant activity in this area funded by PEER and this is reported on later.
41	Sustainability - how will this be met?	Through new ventures such as the International Max Planck Partnership, increased KT activity and service to doctoral training centres where possible. For further discussion see Section 6.

1.4 Key Achievements

1.4.1 Cross Theme

A major cross theme development has been the funding of the International Max Planck Partnership in Measurement and Observation at (and beyond) the Quantum Limit. This spans Photonics, Condensed Matter Physics and Astronomy and has been formed between:

- the Universities of Glasgow, Strathclyde, St Andrews, Heriot-Watt and Edinburgh and
- the Albert Einstein Institute (Hannover and Golm), and

- the MPIs for
    - the Science of Light (Erlangen)
    - Solid State Physics (Stuttgart)
    - Quantum Optics (Garching)
    - Chemical Physics (Dresden)

Funding has been received for a five year period from EPSRC/STFC (£243K), the Scottish Funding Council (£500K) and the Universities (>£5M). A kick-off workshop has been held, funding obtained for a Humboldt fellow and Post Doc at Glasgow, two workshops are being planned and there are relevant SUPA staff appointments at the Universities involved. The formal inauguration will take place on 19 December 2013 by Dr Alasdair Allan, Minister for Learning, Science and Scottish Language.

1.4.2 Photonics

60 academics, 90 research fellows/assistants and 160 graduate students at Glasgow, Heriot-Watt, St Andrews and Strathclyde – some of these researchers are shared with PaLS and Energy.

This has been a very successful year for this theme, currently led by Heriot-Watt and Strathclyde, with

- the opening of the Fraunhofer Centre of Applied Photonics, located at Strathclyde.
- the funding of a centre in laser based production processes at Heriot-Watt.
- the establishment of the Intelligent Lighting Centre at Strathclyde.
- the award of EPSRC programme grants in structured light (St Andrews) and optical communication (Strathclyde).
- the award of a platform grant in quantum states of light (Heriot-Watt) and the setting up of a new research group in Glasgow in quantum technologies.
- the award of two ERC starter grants.
- The award of prestigious prize to Prof Steve Barnett, and a joint award to Prof Miles Padgett and Prof Kishan Dholakia.
- Excellent level of grant income.

1.4.3 Physics and Life Sciences

50 academics, 75 research fellows/assistants and 80 graduate students at Aberdeen, Dundee, Edinburgh, Glasgow, Heriot-Watt, St Andrews, Strathclyde and UWS – some of these researchers are shared with Photonics and Energy.

This theme has been stimulated by having a theme leader (Kishan Dholakia) and two deputies (Tim Newman and Maxim Fedorov) from different areas of the widely distributed theme. Much progress is being made highlighted by a number of developments including:

- Stem cell breakthrough and media coverage from a new collaboration of researchers from UWS and the University of Glasgow. Extensive coverage on BBC Scotland, the BBC World Service and many newspapers presented the breakthrough in growing new bone tissue from mesenchymal stem cells through the use of nanovibrations or ‘kicks’. This is an excellent example of interdisciplinary research bringing techniques from the gravitational wave research at Glasgow and UWS into the life science area.
- Funding of Sonopill research at Dundee with a major grant from EPSRC.
- Award of a prestigious prize to Prof Maxim Fedorov at Strathclyde.
- Winning of a Marie Curie ITN on the Environmental Acclimatisation of Photosynthesis by the University of Aberdeen.

- Winning of a major EPSRC IRC on 'Multiplexed Touch and Tell Optical Molecular Sensing and Imaging', led by Heriot-Watt.
- Winning of a major BBSRC grant in synthetic biology by Glasgow and Aberdeen.
- Winning of other grants in imaging and laser interactions.
- Excellent level of grant income.

1.4.4 Particle Physics

31 academic staff, 37 research fellows/assistants and 64 graduate students at Edinburgh and Glasgow.

This area has been dominated by the discovery of a Higgs type boson and the challenging lack of physical signatures beyond the Standard Model. Highlights include:

- Nobel Prize for Peter Higgs of Edinburgh (jointly with Francois Englert).
- Both Glasgow and Edinburgh played major parts in the experiments leading to the discovery of the Higgs particle.
- SUPA involved in analysis looking for physics beyond the standard model.
- Higgs Centre for Theoretical Physics set up with new positions at Edinburgh.
- Dr Aidan Robson won RSE early career researcher medal.
- Outreach activities take teachers and pupils to CERN and a MOOC is being prepared to bring particle physics to a wider audience.
- New MSc Courses in Theoretical Physics and Mathematical Physics have been developed.
- Two new Higgs prizes have been initiated for school children by the Scottish Government and the IoP.
- Excellent level of grant income.

1.4.5 Nuclear and Plasma Physics

28 academic staff, 45 research fellows/assistants and 59 graduate students at Dundee, Edinburgh, Glasgow, Strathclyde and UWS.

The flagship of this theme is the SCAPA project led by the University of Strathclyde and preparations are well underway for a one year laboratory construction programme starting early in 2013/14. Other highlights include:

- Spin-out of Anacail (Glasgow) a company specialising in ozone generation in sealed packages for the decontamination of food.
- Strathclyde becoming an Associate Member of the Cockcroft Institute of Accelerator Science and Technology.
- P Woods (Edinburgh) receiving the GENCO Award from the GSI laboratory in Germany.
- The production of high energy protons for medical applications by laser bombardment of snow: http://www.strath.ac.uk/media/departments/physics/newsletter/SnowProtons.pdf has been demonstrated.
- Excellent level of grant income as detailed later.

1.4.6 Astronomy and Space Science

52 academics, 74 research fellows/assistants and 77 graduate students at Edinburgh, Glasgow, Heriot-Watt and St Andrews.

The major SUPA supported ongoing research initiatives are the SUPA-scope network of robotic telescopes and the HARPS-North Instrument to search for extrasolar planets at the TNG telescope on La Palma, complementing the research council

funded research on the LISA Pathfinder space mission on the ground based research for gravitational waves with GEO 600 and LIGO, on galaxies and in solar physics. Highlights include:

- The observation by HARPS-North of an object of 1.2 Earth radius having a density similar to that of the earth.
- The delivery of the optical bench for LISA Pathfinder to Astrium for integration towards a launch in 2015.
- Discovery of potentially the most distant galaxy to date by Edinburgh.
- The receipt of a NASA Group Achievement award by Brown, Fletcher, Hannah and Kontar (Glasgow) for the RHESSI Science and Data Analysis Team.
- The award to Hannah (Glasgow) of the RAS 'G' Fowler Prize.
- Excellent level of grant income.

1.4.7 Condensed Matter and Materials Physics

50 academics, 40 research fellows/assistants, and 100 PhD students at Aberdeen, Dundee, Edinburgh, Glasgow, Heriot-Watt, St. Andrews, Strathclyde and UWS universities.

The CMMP research is wide-ranging, from fundamental to applied, and creates large impacts, from high profile publications to potential spin-out companies and providing highly skilled graduates for industrial employment. Broad research topics with critical mass in SUPA include both experimental and theoretical investigations of atomic resolution spectroscopy of correlated electrons, high resolution characterization of novel materials, and solid-state physics at the single quantum level. Additionally, the theme overlaps strongly with the Photonics, Energy, PaLS and Astronomy themes.

Highlights include:

- numerous high profile publications in Journals such as Nature family journals (Hadfield GLA; King and Baumberger St.A; Galbraith and Pidgeon HWU; Loa, Nelmes, and McMahon EDI; Chen x2 HWU, Ferrera HWU), Science (Mackenzie St.A x2), and many articles in Physical Review, Nano Letters, Applied Physics Letters, etc.
- New facilities in the last year to support research activity including the commissioning of the MagTEM facility at Glasgow, a new environmental SEM at Strathclyde, and refurbished labs for Wahl at St. Andrews and Gerardot and Chen at Heriot-Watt.
- Prof Mike Cates (Edinburgh): Weissenberg Prize from the European Society of Rheology
- Prof Robert Stamps (Glasgow): Royal Society of Edinburgh Fellow.
- Prof Robert Hadfield (Glasgow): J&E Hall Gold Medal of the Institute of Refrigeration.
- Dr Phil King (St. Andrews): Gerhard Ertl Young Investigator Prize.
- Excellent level of grant income.

1.4.8 Energy

20 academics, 25 research fellows/assistants, and up to 35 PhD students: Aberdeen, Dundee, Edinburgh, Glasgow, Heriot-Watt, St Andrews and Strathclyde. Almost all members of this theme are members of other themes.

The energy theme strategy is to pursue physics research in three aspects of energy:

(i) solar power
(ii) nuclear power
(iii) complementary activities such as networks, storage and lighting

The energy theme received no direct funding from SUPA and thus its progress is to be strongly commended and is reported on in more detail.

Solar Highlights include:

- the award of a European Research Council Advanced Investigator Award (€2.1M) to Prof Ifor Samuel, first to develop reliable measurements of exciton diffusion, which is a key step in the operation of organic solar cells; then to develop structure-property relations to understand the processes controlling it; and finally to adapt materials and their processing to increase exciton diffusion.
- Organic solar cell research is also enhanced by Prof Hari Upadhyaya beginning his post at Heriot-Watt University, working on dye-sensitised and thin film solar cells.
- Research on the promising thin film solar cell material copper indium selenide advanced, with photoelectron spectroscopy of this material published in Physical Review Letters.
- Energy-related research was a major part of a successful £3.7M equipment bid to the EPSRC 'Capital for Great Technologies' call. Prof Samuel led this bid, working with Prof Irvine (EastCHEM).

Nuclear activity in the theme has two main strands – future "clean" nuclear power from fusion and advanced measurements to help manage nuclear waste. Highlights include:

- Research on laser-confined nuclear fusion continuing to make excellent progress, assisted by Prof McKenna's EPSRC leadership fellowship, and resulting in four Physical Review Letters. Two new EPSRC grants were obtained, one of which links SUPA activity to the UK Plasma Physics HEC Consortium
- The funding from Sellafield on cosmic muon radiography continuing under PI, Prof Dave Ireland, and being an important industrial linkage of the energy theme.
- A new taught MSc in Nuclear Technology which is going to start in Glasgow this September. This includes the development of three new energy-related courses that will be available for students on other taught MSc courses, as well as 4th and 5th year MSci students.

Energy is a broad topic covering many fields that complement the above activities. Of these complementary activities, research is performed on networks, storage, lighting and carbon capture. Highlights here include:

- The networks activity being greatly enhanced by a £506K EPSRC grant on modelling complex systems, and the University of Aberdeen is co-ordinating a new Marie Curie ITN on 'Environmental Acclimation of Photosynthesis'.
- the formation of an Intelligent Lighting Centre at Strathclyde (see also Photonics report).
- Lighting being the topic of a major new EPSRC programme grant on 'Ultra-Parallel Visible Light Communication'. This new project involves the use of solid state lighting to transmit information (see also the Photonics highlights). Hence it aims to combine high-speed communication with efficient lighting and links the Photonics and Energy themes

In addition the Energy theme ran an Organic Photovoltaics meeting (in collaboration with SISER – the Scottish Institute for Solar Energy Research) and the Solar Power session of the SU2P meeting (SU2P is a Scotland-Stanford Photonics collaboration). Highlights here include:

- Co-operation with SISER leading to a grant from the Carnegie trust to support a technician to facilitate collaboration between Scottish Universities and industry. SISER also commissioned the market research firm Optimat to produce a report assessing the potential for solar power in Scotland. The report highlights that there is much greater potential than commonly assumed.

Overall grant income is very significant.

1.4.9 Graduate School

The Graduate School continues to flourish with courses developing in response to the demand and need of students and supervisors, and the Prize Studentship Competition continuing to attract high calibre applications from both international and local pools to undertake a PhD at one of the eight SUPA partner universities. Highlights include:

Physics Courses

- Astronomy Theme: Advanced Data Analysis – relevant to Astronomy, Magnetofluids and Space Plasmas and the Sciences of the Search for Extra-terrestrial Intelligence - has been newly developed for 2013/2014
- Particle Physics Theme: a String Theory Course has been run in 2012/13 (as an output of an Early Career Researcher visit to MIT) and it is hoped to continue this in 2013/2014 and beyond.
- Nuclear and Plasma Physics Theme: development of an MSc in Nuclear Technology (led by the University of Glasgow) for 2013/2014.
- Physics and Life Sciences Theme: new courses in Introducing Biology to Physicists, Biophotonics, Biological Physics and Collective Dynamics in Biological Systems; and the established residential Biology School has been extended to 20 students in 2013/2014 to cater for the high student demand.

Transferrable Skills

A challenging area of course development has been that of transferrable skills. Many of the partner universities run in-house programmes through their graduate schools. However, due to their generic nature, these, on occasion, prove unpopular with SUPA PhD students. In response to this feedback, SUPA has developed the following courses:

- Physics Teaching Workshop (endorsed by the HEA and the IoP).
- Problem Solving for Physicists (new for 2013/2014).
- Hands on Writing: How to Master Scientific Academic Writing.
- Hanging Your (Physics) Research Out in Public.
- Software Carpentry (new for 2013/2014).

The SUPA Graduate School continues to contribute to the ‘Research Ventures’ cross-pools event (organised by the University of Glasgow on behalf of SUPA/SULSA/SINAPSE/SICSA) developing the skills needed for research commercialisation and setting up a business.

Studentships

- The total number of new studentships 2012/2013 was 133, greater than in 2010/2011 but smaller than in 2011/2012.
- The prestigious Prize Studentship Competition that attracts 300-400 high calibre applications from an international pool each year, many of whom are top graduates already with a publication record, is being extended to make prestigious ‘titular awards’ to students funded outside the SFC quota
- During the 2012/2013 reporting period, over 60 nationalities were represented in the Prize Studentship applications, resulting in 22 awards being made for the 2013/2014 cohort – 12 of which are prestigious ‘titular awards’. The calibre of the

applicants and the competition for titular awards has been outstanding and has included a prestigious Carnegie Scholarship student and a Canadian Government sponsored student. Three of the prize studentships were ring-fenced ECRs in the PaLS theme – one to UWS and two to Dundee.

In the absence of future SFC funding to support the 2014/2015 cohort, the SUPA schools have committed to the funding of approximately seven SUPA Prize Studentships via departmental funding and agreed to accept applications for all successful CDTs via this competition.

Impact on Industry and the Economy

- In order to encourage industrial engagement at an early stage, SUPA has set aside £60K from the Placement Scheme to fund short term industrial secondments of physics-related CDT students within Scotland during the course of their PhD programmes.

1.4.10 Knowledge Transfer Activities

The SUPA KT team has been funded since 2010 from both the SUPA Central budget and from various grants. Consequently, whilst the agreed strategic objectives are clear, the operating plan has been formulated and managed to address both the key strategic objectives as well as accommodating the specific obligations of the programmes agreed with the various external funding bodies. The externally-funded programmes within the broader SUPA KT operation include INSPIRE, SEEKIT/ERDF and a fellowship awarded by STFC under their PPARC Industrial Programme Support Scheme (PIPSS). SUPA KT is also responsible for delivering the PEER (FP7/Horizon 2020 engagement) and the SUPA Industrial Placement Scheme. So far (to the end of academic year 2012/2013), the SUPA KT Directorate has:

- funded 21 man-years of executive and secretarial time as opposed to 9 in the original SUPA II plan.
- made a significant contribution to securing at least £1.26M of external grants to the SUPA partners.
- arranged industry partnerships with 14 companies for the students funded under the INSPIRE grant from SFC.
- arranged industrial placements under INSPIRE for early career researchers in seven companies, two in the year 2012/2013.
- finished the SEEKIT/ERDF project with a final five industry support projects completed, making 38 funded in total, leading to approximately £2M additional spend in the companies in two years against a target of £1.2M over five years.
- supported, through the PIPSS fellowship the ongoing spin-outs of two companies, ANACAIL (Glasgow) and Blackford Analysis (Edinburgh), an ongoing KTP with Gooch and Housego, collaborative contracts with four companies, initiated three innovative partnership schemes, one in 2012/2013 and helped an early career researcher at Glasgow to win an STFC/RSE Enterprise fellowship awarded in 2012/2013.
- Supported seven new collaborations including Scottish SMEs for potential participation in EU-funded Framework projects.
- Managed, under contract, the Scottish Optoelectronic Association, part of the Scottish Technology Network Ltd and developing plans to have greater impact in this area.
- Contributed to 17 current patent applications across the Scottish Physics Schools. A further three patents having been granted on ultra fast oscillators, optical coupling devices and a cone refringement laser.

1.4.11 Overall Progress

Progress in all themes is excellent and in most Universities the originally proposed SUPA funded research is progressing to plan. However, the original proposal was submitted in 2008 and then the funding was stretched over seven years rather than four. Thus, to optimise the use of funding and to match updated plans a number of changes of profile were proposed by the participating schools and approved by SFC as follows:

Dundee: November 2012

Original SUPA Proposal: Appoint 1 PaLS Chair, 1 PaLS Lecturer

Following a recent recruitment drive in PaLS theme four world-class applicants applied, one senior, three more junior. The University proposed changing its existing profile to: 1 PaLS Reader and 3 PaLS Lecturers

Glasgow: December 2012

Requested that a fraction of the SPARK equipment budget be designated to personnel in order to pay a suitably qualified Research Technologist/Engineer for approximately one year to procure, install, set up and support the equipment expenditure related to the SPARK investment.

UWS January 2013

Original SUPA Proposal: Appoint 1 Lecturer, 1 Reader

Did not get suitable applications for SCAPA Readership post, did however get strong applications for SCAPA Lectureship post. It was felt that it would be beneficial for SCAPA if two Lecturers be appointed. Requested permission to appoint two SCAPA Lecturers

Dundee: May 2013

Requested that the original change in November 2012 be altered slightly to be:

2 PaLS Readers and 1 PaLS Lecturer

Glasgow: May 2013

Proposed Changes:

Travel Funding SUPA Advanced Fellows: No provision was made in the original funding profile, but travel funding could be met due to a slight under spend on SAF salary costs

Dowry Funding for SUPA Lectureship Appointments: Propose to offer small dowry to new lecture staff – dowries can be accommodated due to a slight under spend on staff salary costs.

SUPA Student in Nuclear and Plasma Physics: Propose an award of 3.5 year PGR studentship, seeking permission to vire funding up to maximum £75K from SCAPA equipment budget line

UWS: June 2013

Initial proposal above together with general delays in recruitment resulted in an under spend. Proposed virement of SCAPA staffing line to a new staffing line to recruit an RA to support group.

SUPA Central – re Restoration of Funds: June 13

Propose that up to £60K be used for three month placements for graduate students associated with the successful bids for physics related EPSRC Centres for Doctoral Training. These placements would normally be with local industries in Scotland.

SUPA Central – re Early Career Researcher Exchange: June 13

Some of the candidates who had been granted an award have had to make adjustments to their visit plans. Proposed that the grant be extended to 31 January 2013.

2 COLLABORATION AND ENGAGEMENT ACTIVITIES

Most areas of physics are highly collaborative in nature, partly due to the use of large-scale facilities, and thus, as demonstrated by the publications, all of our themes have academic partners in the major scientific countries of the world. Within SUPA academic collaboration has been boosted by:

- the Distinguished Visitor program.
- the Prize Studentship competition which has recruited many very high quality students from abroad and these students continue to collaborate when they return home.
- the PEER initiative, encouraging Scottish academics to collaborate with SMEs and colleagues in Europe.
- working with the Science Bridges Programme SU2P.

2.1 Academic

There are four areas worthy of particular note:

2.1.1 International Max Planck Partnership

From SUPA we are launching a new German/Scottish initiative – the first of its kind – an International Max-Planck Partnership between the Physics Schools of five Scottish Universities, and five Max Planck Institutes.

The Universities involved are those of Glasgow, Strathclyde, St Andrews, Heriot-Watt and Edinburgh. The MPIs are: The Albert Einstein Institute Hannover, the Max Planck Institute for the Science of Light, Erlangen, the Max Planck Institute for Quantum Optics, Garching, the Max Planck Institute for Chemical Physics, Dresden, and the Max Planck Institute for Solid State Physics, Stuttgart.

The area of research is Observation and Measurement at the Quantum Limit, an area which has many spin-off possibilities from gravimeters for oil wells to techniques for quantum computing, areas which will be of relevance to the new Scottish Innovation Centre in Sensors and Imaging, to the new Fraunhofer Centre in Applied Photonics and for funding applications to Horizon 2020 under the Future and Emerging Technologies calls.

As mentioned earlier the research councils, EPSRC and STFC, are giving us start-up funding of £243K over a five year period, SFC are contributing £500K over the same period with the Universities each expected to match or even exceed the SFC contribution where possible. Indeed currently the University contribution is exceeding £5M over five years. This should support leverage of further research council and Horizon 2020 funding. Further, the collaborative nature of the research to be undertaken will significantly strengthen scientific links between Scotland and Germany.

We held a technical kick-off meeting in the Spring of 2013 and intend to have an official launch in the winter (19 December 2013) with the Principals of the Scottish Universities, Directors of the Max Planck Institutes, and the main scientists involved. Again as mentioned earlier the Minister for Learning, Science and Scotland's Languages has agreed to formally inaugurate the Partnership at this meeting.

2.1.2 Collaboration Agreement with CNISM

The National Interuniversity Consortium for the Physical Sciences of Matter (**C**onsorzio **N**azionale **I**nteruniversitario per le **S**cienze **F**isiche della **M**ateria, **CNISM**) started its activity on 3 February 2005. It is a non-profit organization comprising 39 Italian Universities and approximately 1300 scientists working in the field of Condensed Matter Physics, and members of CNISM and the Condensed Matter theme of SUPA believe there could be significant leverage by working more closely together.

In many ways CNISM is similar to the SUPA Condensed Matter theme in that it *promotes and coordinates research, scientific activities and related technologies in the field of condensed matter physics among the Universities of the Consortium with the aim of better developing the activities that each University supports in condensed matter*

Thus SUPA, led by the University of Edinburgh and the management of CNISM are in the final stages of formalising an MoU which will provide an excellent basis for developing proposals for Horizon 2020 in relevant areas.

2.1.3 Aberdeen-Lanzhou-Tempe Joint Research Centre for Computation and Complexity

This has particular relevance to PaLS activities and again underlines the strength of Scottish Physical Science in the international scene.

2.1.4 Edinburgh Super Resolution Imaging Consortium (ESRIC)

This consortium is now established having the official launch in July 2013. This collaboration between Heriot-Watt and the Institute of Genetics and Molecular Medicine (EdU) offers a state of the art, world leading super resolution imaging facility, incorporating STORM, PALM, SSIM, STED, FLIM and FCS. The IRC (starting 1 October 2013) will establish a leading interdisciplinary research centre between Heriot-Watt, Edinburgh and Bath to develop transformative fibre based point of care sensing devices for intensive care units. The programme will exploit photonics techniques for real-time, in-vivo imaging with simultaneous sensing of key physiological and pathological indicators in the distal lung and blood lines. A central hub facility will facilitate a strong collaboration between clinicians, physicists, chemists, biologists and signal processors and supplement the intensive multi-disciplinary interactions within each of the teams involved in the programme.

2.1.5 New Academic Partners

This is a very dynamic area where we already have 155 partners as reported in earlier years. More than 60 new partnership agreements have been set up, some with previous partners and some with new

2.1.6 The Research Excellence Framework

This is an interesting but complex area and is coupled strongly with the interactions SUPA has with other research areas such as life sciences and general engineering.

- Edinburgh and St Andrews have particularly strong links in CMMP and Astronomy and decided to submit a joint application to REF 2014.
- Glasgow and Strathclyde had deep discussions and decided that their interests in different areas of physics would be best served by submitting independent applications to REF.
- Heriot-Watt Physics is strongly aligned with Physics, General Engineering, Chemistry and Life Sciences (PaLS theme) and believed that their strengths would be best served by submitting their research outputs and impact statements into all these areas.
- Dundee is very oriented towards Life Sciences (PaLS theme) and have directed their submissions towards Life Sciences and General Engineering.

- UWS is very materials oriented and their Nuclear Physics group, which has undergone serious changes recently, is lacking in Impact Statements. Thus UWS is choosing to submit to Materials and General Engineering.

The variety in submission shows the growing strength in SUPA in cross-disciplinary research! Impact statements for the REF clearly define the contribution from Scottish Physics to a multitude of areas from lasers through sensors to surgical practices but it is not appropriate to detail these here for confidentiality reasons.

2.2 External Partners

The SUPA CEO and the SUPA Executive Committee are very aware of the importance of external engagement and on the need to comment on and try to influence policies which may have a bearing on the health of the discipline. Thus the CEO is a member of the Scottish Science Advisory Council, the Council of the Institute of Physics, the Executive Committee of the European Physical Society and the core group of the Physical and Engineering Science Committee of the European Science Foundation. He also chairs the Education Committee of the Institute of Physics in Scotland. In these capacities he actively takes part in the responses to consultations in scientific, innovation and education areas from Scottish and Westminster Government. The Director of the Graduate School in 2012/2013 was Deputy Chair of the IoP (Scotland) Committee and is Chair for 2013/2014. The KT Director, through the management of the Scottish Optoelectronics Association and involvement in its interaction, is an excellent position to introduce SUPA to a large range of companies in Scotland. For example more than 82 Scottish SMEs have been interacted with by SUPA.

As mentioned above further interactions have been stimulated by the Science Bridges project SU2P which links Scottish physics departments with Stanford and Caltech and by the interactions around PEER.

During the past year we have developed further collaborations with more than 20 companies, some of which we have of course worked with before. Of particular interest are the AMADEUS collaborations between Strathclyde, the TSB and a number of oil companies in the area of investigating carbon capture technologies.

3 OUTPUTS

Some of the outputs are already covered in Section 1 and the remainder are listed here.

3.1 New Staff Posts Created During 2012/2013

	All HEIs incl SUPA appts	**SUPA**
Chairs & Professors	11	2
Other Academic Staff	21	7
Fellows, Post Docs & Research Assts	22	3
Total	**54**	**12**

3.2 Number of Research Students Graduating and Destination

Year	2010-2011	2011-2012	2012-2013
Number of students graduating	92	80	104
Destination:			
Academic	51	47	59
Teaching	1	2	2
Industry	17	11	21
Finance	1	5	1
Technology	3	2	0
Legal	0	1	2
Career Break/Travelling	2	2	4
Unemployed/Applying for Posts	1	4	10
Other ***Publishing/Outreach/Military/Sport/Music**	5	1	3
Not Known	11	5	2

3.3 Size of Early Career Research Community

This comprises 58 lecturers, approximately 268 research staff and 534 research students, all of whom are well catered for by the training events in SUPA discussed earlier and the training provided by the individual Universities.

3.4 Events, Meetings, Workshops and Conferences

There have been more than 23 such events organised in Scotland in the year 2012/2013 but the number of conferences attended by members of SUPA is estimated to be more than 10 times this number.

3.5 Interventions which may Benefit other Sectors including Industry

These include:

- The Fraunhofer Centre in Applied Photonics located at the University of Strathclyde.
- A new super-resolution Structured Illumination Imaging facility for use by biologists, medical staff and others at the University of St Andrews.
- New collaboration being initiated between UWS-Glasgow-Strathclyde and the Queen Elizabeth National Spinal Injuries Unit (QENSIU) at Glasgow's Southern General Hospital to develop new protocols for Whole Body Vibration (WBV) treatment for patients with severe spinal cord injuries.

Development of rapid high frequency scan system (acoustic radiation force impulse (IRFI) imaging) UWS in collaboration with Kings College, Glasgow University, Glasgow Caledonian University, Edinburgh University and Riverside Research Institute (US).

3.6 Outreach and Public Understanding

Every one of the participating schools has major outreach activities ranging from public lectures to the provision of ambassadors for schools. The number of such events per annum exceeds 300 and is one of the reasons that the number of students studying physics in the Universities has increased so markedly over the last four years.

Further, co-ordinated outreach activities across SUPA have also concentrated on enhancing the provision of outreach training for early career researchers. Ken Skeldon and Lucy Leiper of Aberdeen University worked with Avril Manners and Martin Hendry to design a new residential training course 'Hanging your research out in public' for the SUPA Graduate School. This was delivered successfully in April 2013, with excellent student feedback, and will be delivered again in 2014 as part of Glasgow Science Festival, and will include an opportunity for the participating SUPA ECRs to take part in a 'Bright Club' style Festival outreach event for an adult audience. In the past year the SUPA Outreach Group has also worked closely with the Institute of Physics in Scotland to set up a series of regional public lectures around the country; these will be launched during the winter of 2013/2014.

SUPA promotes itself by means of its web site:

http://www.supa.ac.uk/

which has a news section updated constantly to promote issues and events of interest to its membership.

4 GRANT INCOME

Grant income continues to rise particularly in the area of European Framework initiatives and ERC Starter and Advanced awards. Grant income per academic lies well inside the upper quartile for Physics Schools in the Russell Group. The fraction of grants which are collaborative is a measure of the success of the pooling initiative. Note that the cumulative totals in Annex B includes grants which are complete whereas the current grant figures in the Executive Summary and Section 1.1 only contain grants which are currently active.

5 OUTCOMES

As SUPA is less than half-way through its funding period, extended to 2017, it is still too early to discuss potential outcomes. But research grant success, coupled with the formation of the International Max Planck Partnership, feeding applicable research outputs into the new Fraunhofer Centre and into CENSIS are clearly in this category.

6 SUSTAINABILITY

This is a subject which has been under serious discussion inside SUPA this year and the three areas of Graduate School, Knowledge Transfer Directorate and SUPA CEO will be discussed in turn.

6.1 Graduate School

The SFC funding for studentships was fully committed with the offers to the 2013/2014 group of students. However the schools have agreed to fund approximately seven studentships per year from their own resources and to continue the Prize Studentship competition which will also allow excellent students with other funding to be badged as SUPA Prize students. Looking into the future the recommendation of the SUPA Board of Directors has been to cut back on the Graduate School administration from summer 2015 and to seek funding from relevant CDTs. Such a plan, perhaps with a low level of future funding from SFC, is likely to guarantee Graduate School operation beyond the formal end of SUPA in 2017.

However we also need to address ICT capacity and infrastructure. The current expansion of the Graduate School Catalogue of Courses and some future CDT expansion will put greater pressure on the SUPA Graduate School video-conferencing system. The infrastructure which has been set up for video-conferencing within the Graduate School needs review in the light of developments in web-based courses and training. To support these developments, SUPA has, this year, approached SFC for a

sum of £824K to extend the ICT capacity and infrastructure and to develop asynchronous training and enhance existing synchronous video-conference facilities.

6.2 SUPA KT

We have plans in place to extend the positions of the KT Director and Commercialisation Manager well into 2016, although the positions of a Development Manager at Heriot-Watt and the PIPSS Fellow at Glasgow are less clear beyond 2014/2015. This situation is currently under review and depends to some extent on how plans to extend management of SOA and the Scottish Technology Network develop and how SUPA KT can interact with Innovation Scotland and the Innovation Centre CENSIS. Our Board of Directors and International Advisory Committee are of the opinion that one of the main KT outputs from SUPA are our highly trained graduate students and recommend that SUPA KT and the Graduate School rationalise their future developments in this area, a proposal that is currently under active discussion. Some direct support from SFC in this direction would again be welcome.

6.3 SUPA CEO

Currently the SUPA CEO position is part-time, two days per week, and it is felt that this is a satisfactory situation for the future, given the developments with the IMPP and with a potential Higgs-Maxwell Alliance based on funding which may become available following the award of a Nobel Prize to Peter Higgs. We welcome discussion with SFC in this area.

7 CONCLUSION

This has been a particularly successful year for SUPA on all fronts – publications, collaborations and grant income.

The main issue for the future is sustainability and, as discussed, we are developing plans in this area to allow SUPA to continue beyond the cessation of the main SFC funding which is extended to July 2017.

PART 2

Final Report PEER: Ref H11001 and Postdoctoral Early Career Researcher Exchanges Ref: H11002

Interim Report PEER: Ref H11003 and Postdoctoral Early Career Researcher Exchanges Ref: H11004

1 PEER – Final Report Ref H11001

Pools **E**ngagement in **E**uropean **R**esearch, had initial funding of £34,769 from SFC for the development and submission of FP7 bids and the engagement and building of partnerships with Scottish SMEs in that process – January 2012 until July 2013. A further tranche of funding (£31,736) was confirmed in December 2012, which allows this activity to continue and the funds to be used for more general engagement with the EU Framework process, extending the object of the funds to include Horizon 2020 calls.

The first tranche of PEER funding required the involvement of a Scottish SME in FP7 proposals, which limited the scope of proposals that could be supported. Nevertheless, PEER funding was allocated to the development of seven proposals to the following calls, each involving a Scottish SME:

- FP7-PEOPLE-2013-ITN (2 proposals)
- FP7-ICT-2013-10
- FP7-ICT-2013-11 (2 proposals)
- FP7-ICT-PSP-2013-7
- One proposal deferred to Horizon2020

SUPA University	Scottish SME	Call	Detail
Heriot-Watt	M2 Lasers	FP7-PEOPLE-2013-ITN	ULTRAOPTO: Use of specialist consultants to develop Innovative Doctoral Programme bid
Heriot-Watt	mLED	FP7-PEOPLE-2013-ITN	ENCONTRAM: Academic travel to consortium meeting to introduce Scottish SME
Dundee	Envision Design	FP7-ICT-2013-10	FUTURA: Academic travel to consortium meeting to introduce Scottish SME
St Andrews (lead) Glasgow (not Physics)	CST Global	FP7-ICT-2013-11	ENFOLD: Use of specialist consultants to develop bid
Heriot-Watt	Edinburgh Biosciences	FP7-ICT-PSP-2013-7	*CATACURE : Use of specialist consultants to develop bid.
SUPA KT	STN Ltd	CSA – ICT 11	EPCNet: pro rata contribution for use of project manager to co-ordinate bid
West of Scotland	Helia Photonics	Was ICT 11, deferred to H2020	Academic travel to Noliac A/S in Denmark

*This project has been funded with 209K Euro to Heriot-Watt and 357K Euro to Edinburgh Biosciences, their partner SME.

The opportunities of European Framework Programme funding and the availability of PEER funds were promoted to both academics across SUPA and to Scottish SMEs, with presentations given at Heriot-Watt, Glasgow, St Andrews and Strathclyde.

2 PEER – Interim Report Ref H11003

In June and July 2013 PEER was again promoted to SUPA universities in a co-operative marketing exercise with SU2P at a series of 'coffee and buns' events.

A number of announcements of calls and opportunities were sent to the SUPA mailing list as well as targeted communications to academics and university business development staff explaining and promoting the potential use of the PEER service. In particular, the following FP7 calls were promoted in this way:

- Biophotonics ERA-NET Plus
- European Research Council
- ICT-9
- ICT10
- ICT11
- ICT-PSP-2013-7
- Marie-Curie IAPP
- Marie-Curie ITN
- NMP2013-1
- SPACE6

SUPA KT offered to find Scottish SME partners for calls. This led to a number of new relationships, and two of the PEER-funded proposals involved companies and academics that had not previously been in contact.

SUPA KT provided information about the Photonics21 and the other European Technology Platforms. Photonics21 developed roadmaps for Horizon2020 highlighting where funding in photonics was needed to address industrial demand and societal challenges. SUPA KT made the contents of the roadmaps available to SUPA academics (through the SUPA website) and encouraged their participation in the roadmap development.

We conducted a pilot exercise with the PhotonicNet cluster in Germany whereby SUPA academics were invited to send profiles of relevant research interests. These were collated and sent to PhotonicNet, along with more general information on SUPA. M2 Lasers also asked to be included in the submission.

3 PECE: Postdoctoral and Early Career Researcher Exchanges

The strategic fund awarded by the Scottish Funding Council (SFC) for Postdoctoral and Early Career Researcher Exchanges in the year 2011/2012 of £25000 was supplemented by an award of £22500 in year 2012/2013 to be used in AY 2012/13 and AY 2013/14.

3.1 PECE: Final Report : Ref: H11002

As reported in the previous annual report, the first call for applications was put out via the all SUPA mailing list which set out the criteria as specified by SFC in January 2012 with a deadline of 13 February 2012. This resulted in 12 applications (7 Post Docs and 5 PhDs). Applications were made on a standard form and the selection process was carried out by the Graduate School Management Committee (GSMC) at its 14 March meeting. As a result, seven awards were made (7 Post Docs and 2 PhDS). £25,000 was committed to support the following projects:

Postdoctoral and Early Career Researcher Exchange Awards – Tranche 1

Name & Home Institution	Partner Institution	Project
A Bagchi, Edinburgh	MIT	String Theory, MIT (joint with ERPem)
C Demore, Dundee	Pennsylvania State University	Biomedicine Acoustic Tweezing, Pennsylvania State University
D Maneuski, Glasgow	Cyclotron Research Centre	PET Cyclotron Research Centre (joint with SINAPSE)
M Michalowski, Edinburgh	Harvard Smithsonian Centre for Astrophysics	Sub-mm galaxies, Harvard-Smithsonian Centre for Astrophysics
L Reichhart, Edinburgh	Sanford Underground Laboratory	ZEPLIN instrumentation, Sanford Underground Laboratory
N K Gunasekar, Strathclyde	Aalto University	Optoelectric device applications, Aalto University
S Ivanov, St Andrews	University of Seigen	Quantum Computation, University of Seigen
J McArthur, Glasgow	MIT	Standard Quantum Limit, MIT
M Edgar, Glasgow	Rambus Inc., Sunnyvale, CA, USA	Computational Imaging and Sensing, Rambus Inc.

Summaries of reports are given below. More detailed confidential reports are provided in a separate appendix which must be kept confidential.

3.2 SUMMARY REPORTS

Arjun Bagchi: MIT

February – June 2013

One of my main research interests has been non-relativistic AdS/CFT. My hosts at MIT are pioneers in this area. The main motivation behind this exchange was to undertake work to further the possibility that the non-relativistic limit would uncover a new closed sub-sector within the relativistic correspondence that would provide a simpler way of understanding AdS/CFT by using the power of the infinite symmetry structure. Relatedly, there was also the hope that these symmetries would help shed light into some of the outstanding problems in fluid dynamical systems and help pave the way to answering some questions in simplified models of turbulence in lower dimension. It was a truly inspirational visit, as a result of which, I made substantial progress in the above project, I produced a String Theory Course for SUPA and on my return secured a lectureship at a prestigious Indian university.

Christine Demore: Pennsylvania State University

April – August 2013

The aim of the research exchange was to explore theoretically and practically the feasibility of using microfabricated piezoelectric devices as the basis of miniature ultrasound arrays with integrated electronics for high resolution imaging in biomedicine, and as sources for acoustic tweezing. The devices under investigation are piezoelectric micromachined ultrasound transducers (PMUTs) using thin film piezoelectric materials. The research continued from prior fabrication process development at Penn State University, incorporating array designs from the University of Dundee, and a view to integration with device packaging solutions as part of continuing collaboration with Heriot-Watt University, Edinburgh, UK. The developed

devices have been shown to have short pulse-echo responses suitable for imaging and good piezoelectric properties. The outcome of the research has been presented at the 2012 IEEE International Ultrasonics Symposium. Testing and characterisation of the arrays for imaging and tweezing is being continued by researchers from both Penn State University and University of Dundee, and a PhD student from Dundee will visit Penn State University for 3 months as part of continuing collaboration on the research.

Dima Maneuski: Cyclotron Research Centre, University of Liege
September 2012

During the exchange, a novel technique for quality control (QC) in radiopharmaceutical production chain was investigated. The method is based on measurements of radiation emitted from compounds during radionuclide production and radiopharmaceutical preparation. All measurements were performed at the Cyclotron Research Centre, University of Liege, Liege, Belgium. The facility offered access to world class expertise in the area of radionuclide production, radiopharmaceutical synthesis, QC and on-going research activities. The result of the exchange proved the feasibility of the technique for radiopharmaceutical production. The unique features and performance of the system attracted attention for use in related areas of research at the CRC. In particular, it is proposed to test the system for blood sampling during PET imaging, high performance liquid chromatography (HPLC), thin layer chromatography (TLC) and monitoring of the production by-products in the ventilation systems of the CRC. This technique is being examined with respect to filing a patent application in the areas of radiopharmaceutical production and associated processes, an output of the exchange.

Michal Michalowski: Harvard Smithsonian Institute for Astrophysics
August – September 2013

Until now my work was mostly concentrated on the observational aspects of the galaxy evolution. During the exchange at the CfA, more specifically during weekly meetings of the Lars Hernquist group and numerous discussions with its members, I learned the details of the galaxy simulation codes Gadget-2 and Sunrise. This will enable me to use these techniques in the future research to interpret the observational data (e.g. from SCUBA-2 and ALMA). In particular, I will be able to compare the expected properties of given galaxy types with that of real galaxies and therefore learn about the nature of these galaxies. The CfA at Harvard is one of the leading institutes in research on galaxy evolution. Hence, a research stay there is not only prestigious, but also very beneficial in terms of the long-term career. My research has gained a more international dimension by extending the collaboration with the CfA members and I acquired broader skills, which will enable me to study both observational and theoretical aspects of the galaxy evolution. This collaboration will make it easier to successfully apply in the highly-competitive ALMA proposal calls, which will greatly advance my research profile. The results of the exchange will be published in high-impact journals and will provide a long-lasting reference in the study of SMGs, which will be used during the research with coming SCUBA-2 and ALMA data.

Lea Reichhart: Sanford Underground Laboratory
July – August 2012

The LUX350 dual-phase xenon detector at Sanford is at the frontier of its field and will set a new world leading cross-section limit in the case of a null result or will be able to claim discovery of a new particle in the very near future. At the time of the exchange the detector was being installed in the underground laboratory into the finished water tank. The primary aims of this exchange were the establishment of contacts with the LUX collaboration and the familiarisation with the detector system onsite. Both objectives are significant and very important for the future work to be done on the LUX experiment from the University of Edinburgh, which, following successful involvement in the ZEPLIN and DRIFT dark matter projects, has only very recently joined the LUX

collaboration. My main responsibility while working on the experiment was the installation of the gas system and the construction of various gas delivery lines for the detector and subsystems. Through this exchange programme I have gained extensive experience in working hands-on at a world leading experiment, which has been of great personal benefit for my progression as an experimental researcher in this exciting field.

Naresh Kumar Gunasekar: Aalto University, Finland

August – September 2013

During the exchange, Mg doped GaN (p-type) thin films with different concentration of Mg were grown using metal organic vapour phase epitaxy and preliminary studies on light emission was performed by photoluminescence spectroscopy at Aalto. Basic working knowledge on the growth of nitrides thin films was acquired with the help of growth colleagues at Aalto. Samples worth of thousands of pounds were brought back to Strathclyde for further analysis using characterisation techniques, namely electron channelling contrast imaging (ECCI) and cathodoluminescence (CL) hyper spectral imaging. Preliminary work has been started in Strathclyde to characterise these state of the art Mg doped samples grown in the Aalto University. These studies will help to improve our understanding on the effect of defects on light emission in nitride semiconductors. A 30 minutes guest lecture was delivered to the research groups in Micronova entitled “Quantitative micro-structural analysis of nitride thin films in the scanning electron microscope”. This gave an opportunity to explain more about the research work and the facilities available at Strathclyde. After the presentation a number of the researchers were interested in electron channelling and two new projects were initiated. The short term visit was successful in cementing the collaboration work between Aalto and Strathclyde on exchanging samples and joint publications and projects.

Svetoslav Ivanov: University of Seigen, Germany

April – June 2013

The original objective of this visit was to provide solutions to key problems related to processing and storing of quantum information with trapped ions. In the course of the visit, work was focussed primarily on developing a novel route towards scalable Quantum Information Processing (QIP), which rules out the universal quantum gates. Two stages were defined: i) development of theoretical protocols for quantum gates and ii) setting the grounds for experimental demonstrations in forthcoming collaborations. The exchange visit resulted in 2 manuscripts (in preparation), a seminar, a conference talk and a poster presentation and continued, enhanced collaboration with the host institution in Germany

John Macarthur: MIT

September – December 2013

The work done focused on examining the theory and the development of a mathematical model to describe optomechanically induced transparency (OMIT) effects. The experiment was recently carried out at M.I.T. LIGO and the linewidth of the OMIT transparency window was measured to be significantly narrower than previous experiments; 100mHz compared to MHz. With such a narrow bandwidth this gives rise to useful applications in frequency referencing and other optomechanical applications. The quantum theoretical model has been implemented and optical simulation have been performed using Optickle, software that simulates optical response of a system developed in LIGO. The exchange visit confirmed that the mathematical simulation and the experimental results all agree within the error bars and currently, a paper on the results is being written

Matthew Edgar: Rambus Inc, California
November – December 2013

During my visit at Rambus Incorporated I am learning of some of their existing projects within the area of computational imaging and sensing, as well as exploring new experiments based on the use of structured illumination that could be of interest to the company. Computational imaging and sensing is wide and diverse research area with a vast amount of ongoing research from both universities and large technology companies. Manufacturers of smart phones are already beginning to utilise computational techniques to help stand out from the crowd, but the future of mobile technology will likely take advantage of computer vision, not necessarily for human consumption but instead for autonomous information processing from the world around us. An existing Rambus research project that I am learning more about is a device they call PicoCam, which is a low-resolution lensless image processing unit that makes use of anti-symmetric phase gratings to decompose a scene into its spatial frequency components. On a scale of 100microns, it is smaller and cheaper than today□s smallest imager, however in its current form requires heavy computational load and is undergoing development. I am learning about their development of the PicoCam and where possible provide some insight on the various techniques being used. In addition, during my visit I am learning from colleagues at Rambus their design and development strategy for bringing new technology in computational imaging and sensing to the commercial market.

4 PECE: Interim Report Ref: H11004

Further calls were put out via the SUPA mailing list in January, February and August, September 2013 producing 51 applications. These resulted in 7 applicants being offered funding. These applications are listed below, 5 Post Docs and 2 PhD students:

Postdoctoral and Early Career Researcher Exchange Awards – Tranche 2

Name & Home Institution	Partner Institution	Project
D Hughes, UWS	Riverside Research Institute, NY	Cell and tissue mechanical properties, Riverside Research Institute
C Farrell, Heriot Watt	DCG Systems, California	Critical timing fault isolation, DCG Systems
T Metcalfe, Edinburgh	Gravitation Group, University of Aviero	Inflationary cosmology, University of Aviero
C Murphy, Edinburgh	Lawrence Livermore National Laboratory	Positron generation in laser-plasma interactions, Lawrence Livermore National Laboratory
H Reid, Glasgow	Netherlands Institute of Radioastronomy	LOFAR project, ASTRON.
F Cipcigan, Edinburgh	IBM Watson Research, NY	Electronically Coarse Grained Water, IBM Watson, Research.
A Mourka, St Andrews	Institute of Electronic Structure and Lasers	Bio-compatible patterning techniques, Institute of Electronic Structure and Lasers, Hellas

PART 3

Interim Report Use of Restored Funding – SUPA Industrial Placements Scheme - Ref: HR09008

1 Restored Funding - SUPA Industrial Placement Scheme Ref: HR09008

SUPA was granted £450,999 by SFC to design and deliver an industrial placement scheme which would address the following three objectives:

- enhance the employability, entrepreneurial skills and leadership abilities of SUPA early career researchers.
- raise the international profile of SUPA.
- increase the likelihood of lasting engagement of SUPA and/or the early career researcher with industry.

A scheme was devised and approved by the Executive and ratified by SFC. The scheme was designed to be applied for by industrial partners of SUPA (with the encouragement of their academic partners). The first call closed on 31 January 2013 with 12 applications. These were assessed by a panel comprising the CEO, the GS Director and the KT Director. Five applications were selected as most closely matching the objectives, as follows:

Company	University	Comments
Ankon Technologies (China and California)	Heriot Watt	The staff member is Chinese and this has created significant visa challenges. These have now been satisfactorily overcome and the placement should start in September 2013.
IBM (USA)	Edinburgh	The placement was specifically planned for Jan 2014 and all plans are in place.
Nanovation (France)	Heriot Watt Nanovation also has collaborative links with Strathclyde and St Andrews	This project has also suffered considerable visa challenges which have finally (Aug 2013) been overcome and the intern will start in September 2013.
Pixium Vision, Paris	Dundee, with collaborations with Strathclyde and Stanford	This was scheduled to start in Sept 2013 but on the final day for commitment (Jul 31st) the decision was taken by Dundee to postpone the project as they were not satisfied the company had made sufficient commitment to the programme. We continue to work on this.
Unilever (UK)	Edinburgh	Unfortunately, both parties felt it necessary not to go ahead.

As can be seen from the notes above, it is not straightforward to mobilise these internships, particularly when there are visa issues to be overcome. However, the scheme lasts for four years so we can refine the programme management process with experience. It was very encouraging to be heavily over-subscribed with projects, many of which had strong international partners. The next call closed on 30 September 2013 and we have had an encouraging number of enquiries and we anticipate a further batch of strong applications.

SUPA Industry Placements offered Sept 2013

Company	University	Comments
Diagnostic Sonar Ltd Livingston, Scotland	Dundee	
Ceimig Ltd Dundee, Scotland	Dundee	www.ipsen.com
Ipsen France	Edinburgh (PaLS)	
Boulder Nonliner Systems USA	Glasgow	6 week placement
Versatilis USA	Heriot Watt	
Gas Sensing Solutions Glasgow, Scotland	West Of Scotland	Qualified offer, not yet accepted

GRANT INCOME – ANNEX B

Grant income:	2012-13	Cumulative total	Pending applications
Awarded to a single institution within the pool	31,208,497	100,474,552	n/a
Awarded jointly to two or more institutions within the pool	12,348,336	70,025,907	n/a
Awarded jointly to two or more institutions across two or more pools	14,142,693	45,753,473	n/a
Other, please specify*	33,682,569	89,547,413	n/a
Total	91,382,095	305,801,345	67,883,287

*Single SUPA Institutional with external partners

Grant Source	Scottish		UK		European		Other international		Total	
	AY2012-13	Cumulative	AY12-13	Cumulative	AY12-13	Cumulative	AY12-13	Cumulative	AY12-13	Cumulative
Research Councils			49,057,190	221,197,031	9,921,487	21,910,026			58,978,677	243,107,057
European Framework Programmes					23,036,938	37,895,211			23,036,938	37,895,211
Other public bodies*	115,410	1,181,393	7,141,105	18,097,254	215,236	336,741	376,739	901,267	7,848,490	20,516,655
Charities	56,123	56,123	677,262	918,065	0	0	0	0	733,385	974,188
Industry	0	0	308,174	1,892,465	0	187,328	0	516,125	308,174	2,595,918
Other (please detail)	0	0	401,431	463,139	0	0	75,000	249,177	476,431	712,316
Total	171,533	1,237,516	57,585,162	242,567,954	33,173,661	60,329,306	451,739	1,666,569	91,382,095	305,801,345

*Central govt/ local authorities, health and hospital authorities

1 4 9 5
UNIVERSITY OF ABERDEEN

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United Kingdom
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http://www.abdn.ac.uk/ncs/

27 January 2014

Professor James Hough
Chief Executive officer
Scottish Universities Physics Alliance (SUPA)

Dear Prof Hough,

I, on behalf of the University of Aberdeen, do approve the contents of the SUPA II Annual Report 2012-2013.

Yours Sincerely,

Celso Grebogi
Member of the SUPA Board of Directors

UNIVERSITY OF DUNDEE

School of Engineering, Physics & Mathematics.

Dean
Professor Timothy Newman

January 31st 2014

To whom it may concern

I confirm that the information pertaining to the University of Dundee on the SUPA Annual Report is accurate to my knowledge.

Yours faithfully,

Timothy Newman

Dean of Engineering, Physics and Mathematics
Professor of Biophysics
University of Dundee

17 Jan 2014

SCHOOL *of* PHYSICS and ASTRONOMY

The University of Edinburgh
The King's Buildings
Edinburgh EH9 3JZ
Scotland

Telephone (direct dial): +44 (0)131 650 5245
Email: r.d.kenway@ed.ac.uk

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Email: Carol.Borthwick@ed.ac.uk

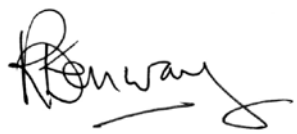
Prof James Hough FRS FRSE
Chief Executive Officer
SUPA

Dear Jim,

SUPA II Annual Report

On behalf of the University of Edinburgh, I approve the contents of the SUPA II Annual Report for the period 1 Aug 2012 to 31 Jul 2013.

Yours sincerely,



Chairman of the SUPA Board of Directors

Professor Richard Kenway OBE FRSE FInstP
Vice-Principal for High Performance Computing and Big Data & Tait Professor of Mathematical Physics

University of Glasgow

College of Science & Engineering

JNC/LE

18 January 2014

Professor James Hough
Chief Executive Officer
SUPA
Kelvin Building
University of Glasgow
GLASGOW

Dear Jim,

SUPA II Report

I, on behalf of the University of Glasgow, approve the contents of the SUPA II Report.

Yours sincerely,

Professor John N Chapman, FRSE
Vice-Principal and Head of College of Science & Engineering

Room 310 Boyd Orr Building
College of Science & Engineering
University of Glasgow
Glasgow G12 8QQ UK
Tel +44 (0) 141 330 4462 Fax +44 (0) 141 330 2359
Email: John.Chapman@glasgow.ac.uk

HERIOT WATT UNIVERSITY

Our Ref: RES/AM/AK

20th January 2014

Professor James Hough
Chief Executive Officer,
SUPA

Dear Jim,

SUPA Annual Report

I, on behalf of Heriot-Watt University, approve the contents of the SUPA Annual Report 2012/13.

Yours sincerely,

Member of SUPA Board of Directors

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Scott Russell Building Gait 3 Heriot-Watt University Edinburgh EH14 4AS United Kingdom
Telephone +44 (0)131 451 3070 Fax +44 (0)131 451 3193 Email RES@hw.ac.uk www.res.hw.ac.uk

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600 YEARS
1413 – 2013

Deputy Principal & Vice-Principal for Research

17 January 2014

Professor James Hough
CEO, SUPA
School of Physics & Astronomy
Kelvin Building
University of Glasgow
Glasgow
G12 8QQ

Dear Jim

SUPA Annual Report 2012-13

I am delighted to approve this report on behalf of the University of St Andrews. Considerable progress has clearly been made over the last year.

Yours sincerely

Chris J Hawkesworth
Deputy Principal & Vice-Principal Research

Professor Chris J Hawkesworth, FRS FRSE
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Tel: +44(0)1334-463202 Fax: +44(0)1334-462543; e-mail: deputyprincipal@st-andrews.ac.uk

University of Strathclyde
Science

DL/NK

16 January 2014

Professor Jim Hough
SUPA Central/School of Physics and Astronomy
Room 234f, Kelvin Building
University of Glasgow
G12 8QQ

Dear Jim,

SUPA Annual Report 2012-13

I, on behalf of the University of Strathclyde, approve the contents of the SUPA Report for 2012-13.

Yours sincerely

David Littlejohn

Professor David Littlejohn

Department of Pure and Applied Chemistry
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Associate Deputy Principal
Professor of Analytical Chemistry
Professor David Littlejohn

WestCHEM

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Scotland

Tel 0141 848 3202
Fax 0141 848 3404

Prof. James Hough

Chief Executive Officer,

SUPA

16 Jan 2014

Dear Jim,

SUPA II Annual Report

I, on behalf of the University of the West of Scotland, approve the contents of the SUPA II Report.

Yours sincerely,

R. Williams

Member of SUPA Board of Directors

Faculty of Science & Technology
Professor R Williamson, Vice Principal (Research and Commercialisation) and Executive Dean