SEPnet engagement with local industries

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Working together to promote excellence in Physics
Outline

• Introduction to SEPnet
• New Innovation Partnership Fellow
• Relevant research in SEPnet
• Examples
• Conclusion
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History SEPnet

• Background (circa 2007):
  – Long term decline in Physics UGs and financial weakness in Physics departments in SE England – Physics was vulnerable
  – Closure of Physics at Reading generated panic in others in a similar state

• Response: £12.5M from HEFCE to fund collective action to form a network of 6 physics departments in the SE to support the discipline regionally

• Focus:
  – Outreach: to boost demand and eligibility for UG Physics places
  – Employability: internship programme to address careers for Physics graduates
  – New Bologna compliant PGT offering ("Euromasters")
  – Research: to underpin teaching and facilitate collaboration
Outreach

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UG Trends – Enrolled per year (source: HESA)

89% growth since 2008
36% nationally

Increase to 2013: 115%
Employer Engagement

**Aims**

- Increase awareness of the links between Universities and businesses
- Survey and assess current trends and requirements of employers, especially SMEs
- Produce qualified employable graduates with the knowledge and skills required to meet industry needs

**Achieved**

- Summer internship programme, placing over 165 undergraduates with 50 regional employers over 5 years
- Established network of 200 employers, via internship programme and employer advisory panel
The internship scheme is growing year-on-year.
SEPnet Phase 2

Expanded Network

Graduate Network

- Public Engagement
- Impact
- Diversity

- Outreach
- Subject Knowledge

- Research
- Employability

- Knowledge Exchange

SEPnet Governance

- Advanced Taught PhD Programmes
- Broad Programme
- Taught Masters
- Staff Development

- Employer Workshops and training
- Mentoring
- Placements and Exchanges
- Alumni

- Prize PhD Studentships
- Workshops and Conferences
- Placements and Exchanges
- Diversity

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Graduate Network

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Impact

- HEFCE support for Diversity & Impact Lead. Prof. Averil Macdonald (0.5 fte)
  - ... 
  - enhance the impact (types, reach and significance) of SEPnet’s research via a clear, collaborative impact strategy

- Agreed funds: £50K per year for 5 years
- Plus: access to £20K per year for Knowledge Exchange (£100K)
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Aims

1. To improve the exploitation of STFC funded research across the SEPnet by transferring knowledge and technologies to industry and to other academic disciplines and thereby enable the STFC mission by developing SEPnet's capacity for knowledge transfer from STFC science.

2. Increase researchers' engagement and collaborative working with industry in order to increase technology transfer activity from STFC funded research across the SEPnet consortium.
Objectives

(i) Identify specific **opportunities for commercialisation** of current research output by engaging with STFC funded colleagues to understand current and potential research projects, and knowledge and skills within STFC funded research groups;

(ii) Understand market need by **engaging with industry, leading to increased R&D opportunities** for STFC technology exploitation and opportunities for working with industry to leverage research funding;

(iii) Develop **effective relationships with a range of industrial and other partners** by working with local KT offices and with SEPnet Employability Officers and through effective marketing;

(iv) Understand trends by **engaging with regional and national networks designed to connect universities and industrial partners** e.g. STFC Innovations Club, www.bizzup.org.uk in Solent region and TSB networking sites;

(v) Identify **opportunities from European funding** e.g. ERC "Proof of Concept" grants and other innovation funding schemes e.g. part of the "Horizon 2020", TSB and STFC innovation funds etc.
Innovations Partnership Fellows

- Two full-time fellows
- starting Oct 2014
- One based at Portsmouth
- One based at Sussex
- Supporting engagement with Physics, Astronomy and Mathematics Research Science SEPNnet
- Also existing fellow at Open University
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Research Themes

- Astrophysics
- Atomic and Condensed Matter Physics
- Particle Physics
- Radiation Detectors and Instrumentation
Research → innovation

Hardware
- Sensors
- Detectors
- Quantum technology

Software
- High Performance Computing, GPUs, Data acquisition systems, On-chip software
- Data Analysis
- Imaging
- Big data
- Modeling
- Simulations

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Hardware

Ultra sensitive, specialized detectors, sensors and the foundations of quantum computing
Instrumentation for the Large Hadron Collider
After processing silicon sensors are not flat

- This is a small, but important, correction for a particle physics detector.

Commercial devices have smaller pixels. Therefore large sensors are much more sensitive to non-planarity.

- Commercial sensors have 5µm pixel sizes (c.f. ~ 50 for HEP applications)
- Edges of sensors have biased images
- We are developing corrections for this:
  - [Now] Modelling in progress, testing using ATLAS Monte Carlo and data.
  - [This year] Acquisition of optical measuring device to facilitate measurements surveys.
- Potential for use in a variety of imaging applications – especially large sensors.
  - Synergy with RAL's TD CMOS imaging group – we can test sensors for real-world applications.
- The final stage would be to engage with commercial partner.
X-ray instruments in space and on the ground

Resonant Inelastic X-ray Scattering (RIXS)

RIXS is a powerful measurement technique used to probe the structure of matter. X-rays illuminate and interact with the material under investigation. By analysing how the X rays change after scattering through the material, scientists can understand more about the underlying structure of the material.

Researchers at the Open University’s Centre for Electronic Imaging (CEI) routinely apply their space instrumentation expertise to complex terrestrial applications.

The Paul Scherrer Institute (PSI) in Switzerland is one of Europe’s largest research centres for natural and engineering sciences. Every year PSI's complex and large-scale research facilities support over 2200 scientists in their quest to better understand the structure and properties of matter and materials from the world around us.

A world-leading facility at PSI is the Super Advanced X-ray Emission Spectrometer (SAXES) that uses a Charge-Coupled Device (CCD) camera to perform Resonant Inelastic X-ray Scattering (RIXS), a technique that probes the electronic and magnetic properties of materials.

A desire by PSI researchers to increase the performance of SAXES led to collaboration with OU researchers who were able to do just that, using know-how developed through years of instrument development for space-based X-ray astronomy missions.

Following proof of principle experiments, a 200% performance boost to the spectrometer is predicted by applying new Electron Multiplying-CCD (EM-CCD) technology in combination with advanced data processing techniques. This will result in researchers getting a much 'clearer' image of the processes occurring in the materials that they are investigating.

With OU researchers having demonstrated these improvements, PSI has initiated an upgrade of the SAXES camera system with UK companies selected to develop and supply it.

For further information visit http://www.open.ac.uk/biomedical-research-network/about-us
Down to Earth
Translating Space Know-how to Healthcare

Exploration of our solar system pushes the boundaries of science and engineering. Our collaborative, multi-disciplinary approach has delivered successes on the international stage and is underpinned by our strong pedigree in the development of bespoke analytical and technical solutions to the customers’ needs.

In particular, the application and development of a wide range of bespoke mass spectrometer-based systems that enable us to determine the physical, chemical and isotopic composition of extra-terrestrial materials in the laboratory (lunar and meteorite samples) and in situ (Cassini-Huygens, Beagle2 and Rosetta missions). Encouraged by ESA, STFC and UKSA, we have been collaborating with external partners to explore how these capabilities can be translated to terrestrial challenges. This has included the successful delivery of an award winning environmental monitoring system for the Ministry of Defence.

Healthcare is also proveing a fruitful area for these capabilities. A series of collaborative studies have indicated that in addition to deployable instruments, for point-of-care applications, that the laboratory-based systems have much to offer in biomarker discovery, disease classification and target compound profiling.

Applications
- Point of Care Disease Diagnosis
- Novel Disease Classification Methods
- Steroid Profiling
- VOC Profiling
- Forensic Analyses
- Safety Critical Atmospheric Monitoring

For further information visit
www.open.ac.uk/science/physical-science
Quantum Technology

Dr. Winni Hensinger: University of Sussex
Software

Image analysis, Data analysis, Big Data, modeling and simulations
EFIT-V

used by more than 70 police forces internationally

University of Kent

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Functional CT imaging of the heart

- HEP manages large data sets:
  - Pattern recognition and data mining are central to these aspects.
  - Recognising signal from background is key.
    - Current clinical studies require ventricles to be defined by hand as a function of time.
    - From this blood flow can be computed.
    - Trace uptake (and dispersion) can be used to identify scar tissue.

- Starting to explore synergy between PPRC and the Royal Chest Hospital to see if application of modern fitting and multivariate techniques can be used to automate the diagnostic process.
  - Have identified some easy wins that could help improve diagnostic capability.
  - The more challenging main goal is the automation of tissue wall boundary definition.
  - Applications beyond cardiology in the longer term.
Automatic Classification Software for fMRI brain scans: A Diagnostic tool

fMRI images From Sussex CISC

Gaussian Processes Methodology

Prof Seb Oliver, University of Sussex STFC Funded Global Challenge Concepts project

False positive rate = 1 − specificity

True positive rate = sensitivity


Mild Cog. Imp. Vs Normal
Electronic Patient Record Linkage

Astronomy from ESA’s Herschel mission

Bayesian probabilistic Matching
Hurley, Oliver, et al.
University of Sussex
Applied to...

European Cystic Fibrosis Patient Registry
Electronic Patient Record Linkage

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Astronomy from ESA’s Herschel mission

(B)ayercet in prep.)

European Cystic Fibrosis Patient Registry

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HEP and Next-gen Proteomics

Mass-spectroscopy is the workhorse of proteomics

Goal: Apply techniques from the search for the Higgs Boson to LC-MS/MS and related workflows to bring step-change in identification and quantitative measurement of low concentration proteins in biological samples.

Target areas:
- Data handling and processing in the cloud – Data reduction and Grid technologies
- Search for low concentration species in biological samples – Event triggering and background removal
- Improved methods in simulation for experiment design and data analysis for targeted protein quantification – Large scale Monte-Carlo based simulation

Currently in very early stages – building collaboration with bioinformatics colleagues at QMUL to advance to proof-of-concept stages. Will be seeking eventual clinical and commercial partners.

Jon Hays
Simulations

Prof. Peter Thomas, University of Sussex
Prof. Peter Thomas, University of Sussex

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Flood Modelling

Prof. Peter Thomas, University of Sussex

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Summary

- SEPnet is open to business
- 2 new Innovations Partnership Fellows
- Front-line Research within SEPnet has a very rich variety applications