Statement of Need for a Mid Range Facility

Final Draft

1. Please state the type of facility and give a brief description of its function.

This is a statement of needs for an Ion Beam Facility. As will be noted in the following document such a facility already exists and has been shown to provide access to a wide range of specialist researchers in fields including Ion Implantation, Biomaterials, Polymer Science, Microelectronics, Forensic Science, Archaeology and Nano-structured materials. It should be a versatile centre capable of providing an extensive range of mono-energetic ion beams with energy of between a few keV to a few MeV. The beam lines and accelerators need to be configured in such a way as to be able to support application of the ion beams for materials analysis, materials modification and radiation biology.

For **Ion Beam Analysis** it needs to be capable of providing submicron diameter beams for Particle Induced X-ray Emission) PIXE, (Rutherford Backscattering Spectroscopy) RBS, (Elastic Backscattering Spectroscopy) EBS, (Nuclear Reactions Analysis) NRA, (Elastic Recoil Detection) ERD, (Ion Beam Induced Charge) IBIC and (Ion Beam Induced Luminescence) IBIL applications. It should have an external (samples in-air) analysis capability. It needs to be able to analyse radioactive materials and provide analysis using neutron, deuteron and tritium beams. It should have a goniometer suitable for channelling measurements for defect analysis in single crystals. The data analysis is not trivial in general and clients must be able to obtain help to interpret this and be provided with training as necessary.

For **Ion Beam Modification** it needs to be capable of implanting a wide range of ions across the periodic table with single isotopic purity into a range of materials. The implantation facilities should be capable of presenting targets to the beam in a controllable orientation and at a controllable temperature and environment. Accelerated gas atom clusters and molecular ions would be desirable. *In situ* analysis during implantation should be available, such as TEM (Transmission Electron Microscopy) and LDLTS (Laplace Deep Level Transient Spectroscopy) for defect studies. There should be a base-line level of post- (and pre-) implantation processing available, such as rudimentary masking and thermal processing. Quality control of both uniformity and absolute dose is paramount and must be supported by a QA (Quality Assurance) program and be ISO9001 certified.

For **Radiation Biology** a cell irradiation facility is required that allows living cells to be presented to the ion beam without being taken from their nutrient medium. It should be possible to irradiate up to 60,000 cells per hour (to ensure that rare end points can be observed) in a controlled fashion that allows regions within each cell to be precisely targeted with single or multiple ions. The targeting in this system needs to allow specific cell features to be precisely targeted (i.e. beam diameter < 0.5 micron positioned to < ±1 micron).

In general the facility should be active in developing the application of ion beams and the associated software tools for acquisition and interpretation and engaging UK industry and academia in exploiting this technology as new capabilities become available. It should also be capable of training research workers, including students, in the application of ion beams.

2. Is this an existing UK facility or is it a new facility? If it is a new facility, please explain why this facility is now needed or will be needed in the future.

This is an existing UK facility at Surrey with additional components elsewhere.

The Centre at Surrey fulfils most of the requirements of the user community. Although the Van de Graaff at Salford has closed there remains an *in situ* ion beam facility there served by TEM. Neutron, deuterium and tritium beams are regularly used in a secure laboratory at Cranfield University (Shrivenham site) where it would be possible to house a new beam-line to support the analysis of radioactive and other potentially hazardous materials which are difficult to move overseas. Such work has, until now, been taken on by Sussex, but that Van de Graaff is closing down in 2010 and its users need a new facility in the UK. The Surrey was completely refurbished between 1991 and 2001, continually adding new component since then. The Durham facility was built in 2001 to satisfy the growing demand for ion beam analysis particularly for polymers. The Durham facility has developed a large collaborator base of both external and internal users of its facility.

New developments in the application of accelerated cluster and molecular ions – pioneered at Kyoto University in Japan and in production at Epion in the US – suggest that such a facility for the development and exploration of thin films and coating production processes would lead to novel coatings with improved qualities. Access to such a facility would allow researchers to explore new coating and surface treatment conditions and to demonstrate new ideas of benefit to the UK

3. What facilities of this type already exist (a) at the university level, (b) at the national or regional level and (c) at the international level. How accessible are these existing facilities to UK academics?

The facilities brought together at the current national centre, the Surrey Ion Beam Centre**,** are unique, but some additional facilities can be found both in the UK and across Europe.

a) It is not normal to find such facilities in every University
b) In the UK the following ion beam facilities exist:
    - Surrey University Ion Beam Centre
        - Equipment – 2keV – 4MeV implantation with in-situ LDLTS; 2MV Tandem accelerator with bio-irradiation facility, external beam and sub-micron focussed beams.
        - Accessibility – via EPSRC grants, commercially or via pump priming projects
    - Salford University
        - Equipment - 100kV implanter with *in-situ* TEM; low energy implanter 50eV – 80keV.
        - Accessibility - External user access will be available soon.
    - Sussex University
        - Equipment – 3MV Van de Graaff for IBA
        - Availability - closing down in 2010
    - Cranfield University
        - Equipment - 2.5MV Van de Graaff for IBA
        - Accessibility – Largely internal usage and through collaboration
    - Durham University
        - Equipment - 1.7MV Tandem for analysis of polymers
        - Accessibility – similar numbers of internal and external collaborators
    - Isotron (Harwell)
        - Equipment – 5MV Tandem
        - Accessibility – commercial rates
    - Ion Beam Services (MidLothian)
        - Equipment – Implanters (2keV to 160keV for standard semiconductor doping) and Plasma Immersion Ion Implantation equipment for surface doping and treatment.

    - Accessibility – commercial rates
- Smart Implant (Didcot)
    - Equipment – 5keV-160keV Implanters (100mm & 150mm) wafers
    - Accessibility – commercial rates

c) There are a number of laboratories across the EU with ion beam facilities. No single facility has the complete range of services required. Most are unaccustomed to providing a user service. The bio-irradiation provision does not fulfil the required irradiation rate (60,000 cells an hour) nor the in-medium requirement as they all have horizontal beams. Although the majority offer some form of analysis not all of the techniques are available in all of the institutes.

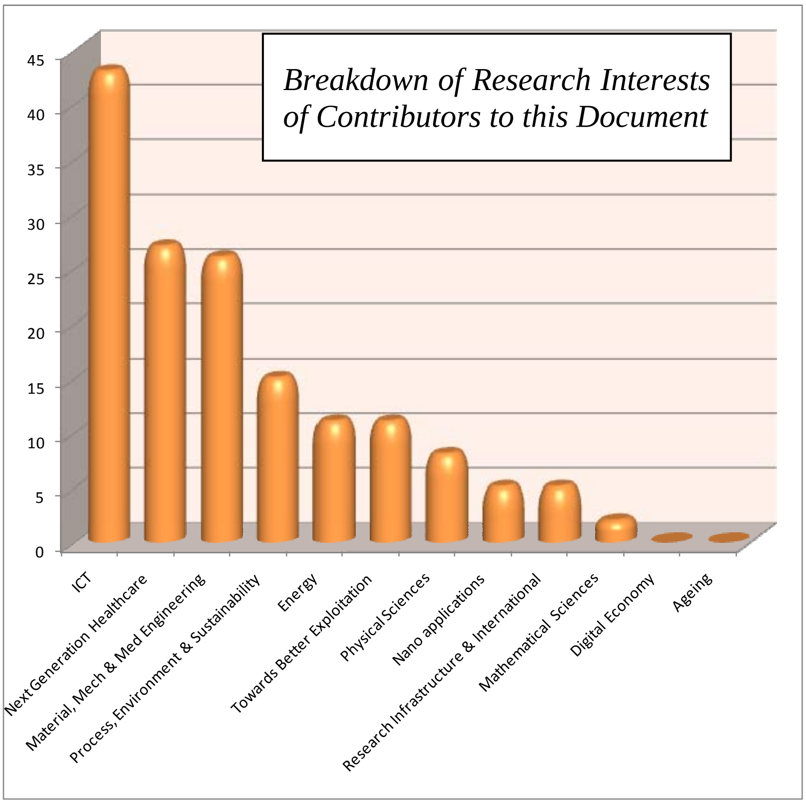
Place	Country	Materials Modification	Regular User Access	QA program	In-situ TEM	Bio-irradiation	Analysis	External Beam	Sub micron Focusing
Leuven	Belgium	x		x			x		
Namur	Belgium						x	x	
Zagreb	Croatia						x		
Prague	Czech Republic						x		
Jyväskylä	Finland	x	x				x		
Helsinki	Finland	x	x				x		
Caen	France	x							
Bordeaux	France		x	x			x	x	x
UPMC	France			x			x	x	
Louvre	France						x	x	
Saclay	France			x	x	x	x		
Dresden	Germany	x	x	x			x	x	
Darmstadt	Germany	x	x			x			
Jena	Germany	x					x		
Kiel	Germany						x		
Leipzig	Germany	x					x		x
Bochum	Germany	x				x	x	x	x
Garching	Germany					x	x	x	x
Göttingen	Germany	x					x		
Demokritos	GR		x				x	x	
Debrecen	Hungary						x	x	
Catania	Italy	x		x			x		
Bologna	Italy	x							
Utrecht	Netherlands	x				x	x		
Krakow	Poland	x							
Lisbon	Portugal						x	x	
Belgrade	Serbia	x					x		
Bratislava	Slovakia						x		
Ljubljana	Slovenia						x		
Madrid	Spain						x		
Seville	Spain						x		
Uppsala	Sweden	x							
Ankara	Turkey								

4. Please describe who will benefit from the existence of this facility, including the number and type of researchers in the UK who are likely to want to use it and the research disciplines that it will benefit. Please indicate what level of usage such a facility would get in a year.

Over 160 people have been consulted in the production of this document. They represent 92 different research groups across 32 universities and 30 companies and government agencies within the UK. The figure below give an approximate breakdown of research interests of the contributors to this document into the main EPSRC funding categories.

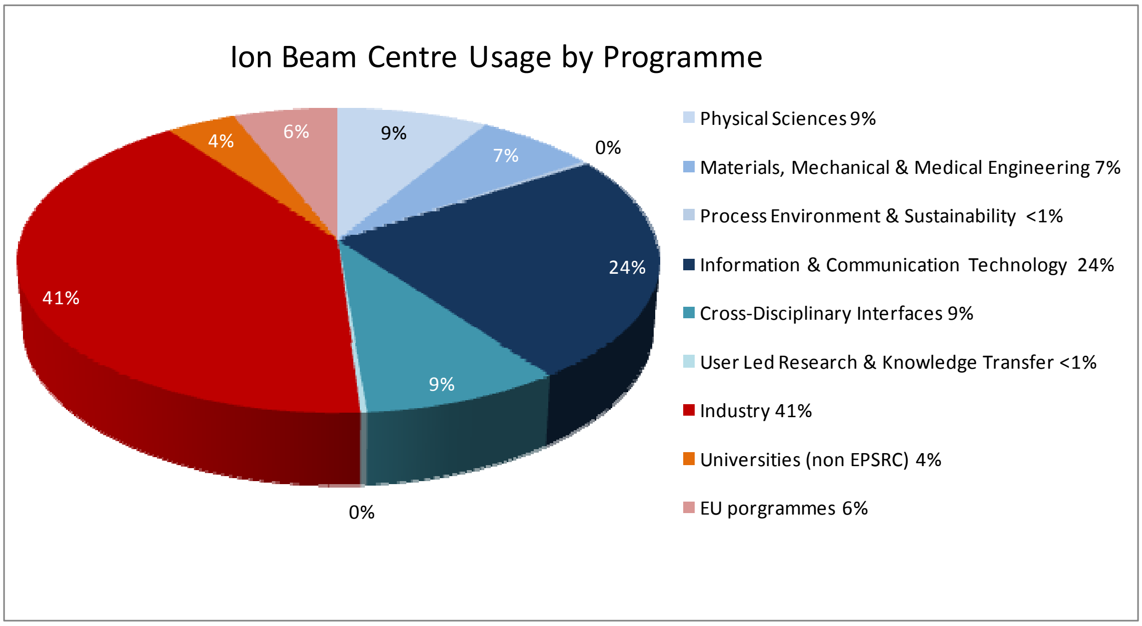
Ion beams of the type suggested in this application support many applications areas. Traditionally these facilities have supported the nuclear industry in understanding radiation damage and plasma surface interactions; the electronic and electrical industries for device fabrication in semiconducting, superconducting, photonic and photovoltaic materials; and materials science in fabricating new materials and surface coatings.

Ion beam analysis is routinely performed on all the above as well as objects of cultural heritage in both provenancing as well as in understanding the creation and preservation of objects. Unique procedures have been established for analysis of the metallic content of proteins for which there is no other technique available. With recent advances in beam resolution and data manipulation these techniques are now being used in a variety of multidisciplinary applications such as analysis of forensic materials, geological and cosmological samples and for biomedical investigations. New facilities have also been introduced to provide understanding of the interaction of ionising radiation with living matter, to help improve our understanding of radiobiology for cancer studies and radiation protection in environmental and occupational health. New sub-micron beam sizes also enable the direct writing of high aspect ratio and overhanging structures on the nanometre scale.



The general provision of a gas atom cluster and molecular ion source for shallow doping and surface treatment is not available in the UK – this should not be confused with the metal cluster deposition work going on in many places in the UK (eg Prof Palmer in Birmingham). The application of accelerated large gas atom clusters to materials modification is relatively new having been pioneered by the group in Kyoto for application in the semiconductor industry providing a new technology for surface smoothing and a new technique – known as "infusion doping" – for shallow doping profiles.

The current facility supports £73M worth of EPSRC project grants over a 4 year period. On average it has provided these projects with about 1000 hours of beam time per year. It also provided 400 hours of pump priming time per year and a further 200 to support its QA programme. Over the past 3 years 66 pump priming projects have been awarded. Of these 50 are from outside of Surrey, showing that access opportunities are available to all. It also provides a further 1000 hours for industrial and EU projects. A breakdown of the current usage by research programme is shown below.



5. Please explain why this facility is a "mid range facility" and what the benefits are of EPSRC supporting this facility. That is, why the facility needs to be supported at a national or regional level, rather than at a University or international level.

The requested facility is a mid range facility because the basic capital cost of the equipment (including three small accelerators) for such a facility is in excess of £5M. The current facility grant awarded by EPSRC is £2.3M with a further £1.6M for user access. It requires specialist knowledge to ensure that the equipment is exploitable by the non-specialist. This is usually achieved by providing scientific staff to work alongside the users in both analysis and irradiation. The current equipment is in use by many groups around the UK *via* full grant and pump-priming access. The current facility supports £73M of EPSRC grants, demonstrating a substantial return on the £4M EPSRC facility funding.

Many projects supported by this facility are cross-disciplinary, unified by a common technology, and involve specialists from the facility working with those from the user community. Many users come from other universities and public bodies in the UK and provide a substantial impact on the UK economy and society. To be cost effective, the facility should be concentrated on a small number of sites in the UK where it can continue to stimulate and promote new scientific ideas for the benefit of the UK

It is envisaged that such a facility would work closely with one of EPSRC's Knowledge Transfer Accounts (KTA) to facilitate active knowledge exchange and ensure that its full socio-economic impact is explored, developed and benchmarked. Pump priming and training activities are also fundamental in allowing quick turnaround and development of new ideas. These functions would be seriously inhibited without UK facilities. Some aspects of high profile forensics work make shipment of samples outside the UK difficult if not impossible. Having the facility overseas would limit the use of ion beam techniques for forensics work. Likewise the analysis of cultural heritage artefacts held in British collections, requires them to stay inside the country. The same applies to radioactive samples. If the bio-irradiation facility were to be outside the UK there would be difficulties in transporting the cells across national boundaries and would therefore imply that the cell culturing and growth would have to be done remotely – potentially limiting the cell lines available and putting at risk the intellectual property of UK institutions

6. How long should the facility be supported for?

The lifetime of the accelerator equipment in such a facility can be as much as 40 years. The end stations and beam lines, being continually under development, have a shorter life. Looking to the users, the R&D for fusion energy projects is expected to take 40 years, after which commercial power generation might begin. The semiconductor industry, even at the leading edge of development, expects to require ion implantation for the next 10 years. RBS celebrates its 100^{th} anniversary this year, has been in active use for 50 years and will surely remain a standard technique. Ion beam analysis still offers premium capabilities and continues to be developed – a new EU grant which brings together ion beam centres around Europe (including the UK) has two work packages specifically aimed at developing the state of their art.

The current facility has been providing beam time to the community through SRC, SERC and EPSRC grants for more than 30 years. The current staff at Surrey has many man years of experience of ion beams between them. It is crucial to ensure that the wealth of experience in such a centre is not lost, it is essential to provide support that provides stable employment for its staff members. Project grants requiring an ion beam facility have typical durations of 1 to 6 years and facility funding should at least match the project timescales. A 4 or 5 year rolling grant model has been suggested as a useful way of providing a reasonably long term provision with built in reviews every 2 or 3 years. Supposing the facility were no longer to be supported in consequence of a review, the users would have two years to find other facilities and the staff a period in which to find other jobs.

7. Please indicate what the facility should provide to be of maximum benefit to the research community and estimate the likely cost of the facility. For example, indicate what size should it be, what technologies should it have available, how many staff would it need. You should prioritise these requirements in terms of "must have" and "desirable". In addition, please highlight any features that would be detrimental.

The facility needs to provide:

- well controlled **ion implantation** facilities with better than 2% uniformity over a 150 mm wafer sample area and better than 10% fluence accuracy for ions across the periodic table. Energy range should be from a few keV (or lower) to a few MeV (or higher). Standard (state-of-the-art would be desirable) semiconductor processing and metrology equipment should be available and sample chambers should be housed in a class 100 clean room. The end station should be flexible, so that samples from a few square mm up to 40cm square can be irradiated. Temperature of the implantation should be controllable from 10K (preferably a few mK) to 1250K. *In situ* monitoring with DLTS and TEM (XPS and Raman would be desirable) should be available. A regular QA programme should be maintained. A facility for employing gas atom cluster implantation would be desirable. Simultaneous beams (as at JANNUS) would be desirable to better model the fusion reactor surfaces. Focussed proton beams should be capable of providing ultra-high resolution high aspect ratio lithography.
- **Ion beam analysis** facilities employing, RBS, EBS, PIXE, PIGE, NRA, ERD, IBIL, IBIC (MeV SIMS (Secondary Ion Mass Spectrometry) for sub-micron in-air molecular analysis would be desirable) and combinations of all of these. High resolution detectors for PIXE (calorimetric) and particles (time-of-flight) would be desirable. The IBA techniques should be available using broad beams as well as sub-micron focussed

beams for imaging and mapping of small particulates – for these an SEM (Scanning Electron Microscopy) capability in the end station will be needed. An external beam capability should be available to provide analysis of vacuum sensitive samples, with the ability to control the external environment. A facility to perform analysis of radioactive samples in a screened laboratory is now required.

- **Bio-irradiation facilities** capable of irradiating 60,000 cells per hour with the cells in liquid media. This should be capable of shooting one ion at a time with sub-micron precision and in a continuous mode for analysis. It should be capable of working with ions up to and including Ca. The end station should be an environmental chamber, with state of the art tans and epi fluorescence microscopy, single photon detection and a fast scanning stage, all surrounded by a cat 2 bio clean room with facilities for cell culture and incubation.

The facility should provide pump priming access to the UK community to provide rapid access for small high risk projects. It should continually develop its resources and capabilities and adequate money and access time should be available to allow this to happen.

The facility should provide access for training and to support EPSRC Doctoral Training Centres (DTCs) around the UK.

It should provide a "one-stop-shop" for ion beams – even if the capability is not available at the facility it should be able to suggest where it can be found and to act as a broker for other facilities in the UK and the rest of the world. As a part of this it should be performing a Foresight role, looking for new opportunities to exploit its facilities with UK academia and industry.

The current facility at Surrey, including user access, costs about £5M over 4 years. The current staff complement seems to be a little low and more posts would allow more specialists to be available in-house. The current facility does not completely satisfy the current requirements, but within the UK the required provision and increased usage can be found for an estimated additional £3M over 4 years. However the requirement for analysis of radioactive materials is currently being undertaken at Sussex, which is closing its accelerator, some funding (~£150k) will be needed to re-instate this facility elsewhere.

8. If EPSRC was unable to support this facility, what would the research community do? (for example, in terms of looking for other sources of financial support or seeking access to non-UK facilities)

Surrey has the only scanning vertical ion beam facility in the world. Without it many experiments upon the fundamental biological effects of radiation at the cellular level will not be performed. If only horizontal beams are used, such as might be available in Munich or Bordeaux the living cell could not be studied dynamically as radiation dose accumulates. Furthermore those other facilities will not have the throughput of cells possible at Surrey and this would compromise the accuracy of any data and limit the amount of material that could be treated in a portion of a cell cycle. If the Surrey machine were to be lost many important experiments will not be performed and the development of new radiation therapies in the UK will be delayed to the grave disadvantage of some patients of the NHS. As a single example, experiments currently planned to determine the effects of chemotherapeutic agents during irradiation would be lost

The nuclear industry in the UK is being given new impetus and for fusion reactors radiation damage has been identified as a key area in proving their commercial feasibility. Without ion beam facilities to enable the simulation of high dose effects researchers will need to find ways of shipping radioactive samples overseas or move this aspect of its research overseas to the disadvantage of energy-related R&D in the UK.

For the UK Home Office some forensic and homeland security work will not be carried out because samples cannot be taken outside the UK.

UK companies currently using the ion implantation equipment for more unusual ion species or energies will be faced with the prospect of funding a new centre to do the work – which might increase substantially the costs of manufacturing making their devices and products commercially uncompetitive. Certain product lines would disappear and the UK would be economically disadvantaged.

It would be possible for some of the required ion beam time to be satisfied at Rossendorf in Dresden, however their experience in working with semiconductors is relatively new, they do not have a bio-irradiation facility and their ion beams for analysis are not as highly focussed as those at the existing UK facility.

If there were no facility in the UK then there would be a loss of pump priming and training and the UK would be in a weaker position to be able to take up high tech projects.

Apart from Salford only the JANNUS project at Saclay in France has an *in situ* TEM capability on a beamline. Its availability now and in the future for extensive projects form the UK is uncertain.

In general the users represented here do not have much influence on ion beam facilities overseas and if the national facility were curtailed the UK would lose its role and standing in the international community.

9. Please make any other comments that you think are relevant to the statement of need for the facility.

The current centre has a leading international reputation and is a precious resource staffed with very high quality people of great expertise and experience. The favouring of other centres in a tendering process looking only at price could diminish the quality of data and hence inhibit research of importance to the EPSRC.

10. Who was involved in preparing this statement of need? Please list name, institution and research interests.

The following list represents people who have contributed, or have had an opportunity to contribute, to this statement of need by attending a community meeting at the IoP on 5th May and/or electronically via email and an on-line submission process at http://www.ionbeamcentre.co.uk/consultation. Versions of this document were available for comment by the community and people were invited to make comments on the statement prior to its submission to the EPSRC. Everyone on this list expressed an interest in the content and was given several opportunities to opt out prior to submission. The people on this list represent 93 different research groups across 32 Universities and 31 companies and government agencies.

1st name	Surname	Company	Faculty/Division	Research Interests
David	Armour	University of Salford	Institute for Materials Research	Radiation damage, Ion implantation, ion beam analysis, atomic collisions in solids
John	Armstrong	National Policing Improvement Agency	Police Science & Forensics Unit	Forensics
Peter	Ashburn	University of Southampton	School of Electronics & Computer Science	Microelectronics, nanotechnology, biosensing
Melanie	Bailey	University of Surrey	Ion Beam Centre	Forensic applications of ion beams
Greg	Bale	e2v Scientific Instruments		Silicon radiation sensors manufacture and qualification
Naci	Balkan	University of Essex	School of CSEE	Ion implanted solar cells
Paul	Barber	University of Oxford	Gray Institute for Radiation Oncology & Biology	Biomedical - nanobeam
Gretchen	Benedix	The Natural History Museum	Dept. of Mineralogy	Meteoritics, planetary science
Nick	Bennett	Newcastle University	School of Electrical, Electronic and Computer Engineering	Nanoelectronics
Sukanta	Biswas	Cascade Scientific Ltd	Evans Analytical Group	Semiconductors, Photovoltaics
Stephen	Bleay	Home office	Scientific Development Branch	Forensic science (specifically fingerprint research)
Roy	Blunt	IQE (Europe) Ltd		Semiconductors
Marco	Borghesi	The Queen's University of Belfast	Department of Physics and Astronomy	Laser-plasma interaction Laser-driven particle acceleration Radiation damage
Mim	Bower	University of Cambridge	Mc Donald Institute for Archaeological Research	Archaeology, DNA from parchments
David	Bradley	University of Surrey	Physics Department	Biomedical applications of ion beams
Lucy	Bristow	Thames Valley Police	Fingerprint Bureau	The forensic applications of the Ion Beam, with a particular interest in fingerprints.
Peter	Bull	Oxford Centre for the Environment		Forensic Geology
David	Caplin	Imperial College London	Blackett Lab	Irradiation of solid state materials, in particular, superconductors.

Albert	Carley	Cardiff University	School of Chemistry	Surface chemistry and catalysis; surface characterisation
Sharon	Cather	Courtauld Institute of Art		Cultural heritage
Robert	Cernik	Materials Science Centre		Functional ceramics, detector development II-VI semiconductors
Richard	Chater	Imperial College	The Materials Department	Ion surface interactions, surface analysis, focussed ion beams
David	Clark	Raytheon Systems Limited		Ion implant into silicon carbide, including high energy implants and high temperature implants.
Paul	Coad	UKAEA/EURATOM	Fusion Laboratory	Fusion energy research, surface analysis of plasma-facing materials
Paul	Coleman	University of Bath	Dept Physics	Defect evolution in ion-implanted semiconductors
Helen	Coley	University of Surrey	FHMS	Cancer biology and new platinum based anticancer agents.
John	Colligon	Manchester Metropolitan University,	Surface Coatings and Characterisation Group	Ion-surface interactions, Ion-assisted deposition, energy-assisted coatings for various applications: getter surfaces for large accelerators, hard nanocomposite coatings, corrosion protection, high temperature MAX phase coatings, photovoltaics.
Stuart	Coomber	QinetiQ	Malvern Technology Centre	InSb based (narrow gap) semiconductor materials
Nick	Cowern	University of Newcastle	School of Electrical, Electronic and Computer Engineering	Silicon related materials for nanoelectronics and photovoltaic technology
Wayne	Cranton	Nottingham Trent University	School of Science and Technology	Materials processing and characterisation - thin film technology - plastic and printed electronics - laser processing
Richard	Curry	University of Surrey	Advanced Technology Institute	Optoelectronics
Gordon	Davies	King's College london	Physics Department	Radiation damage in semiconductors
Carine	Davoisne	Imperial College London		radiation damage and noble gas accommodation in ceramic for nuclear use
Lorna	Dawson	Macaulay Land Use Research Institute		Soil, forensics, organic matte
Vanessa	De Castro	University of Oxford	Department of Materials	Radiation damage in structural materials for fusion reactors
Bob	Denning	University of	Inorganic Chemistry	Photovoltaic Device Structures

		Oxford	Laboratory	
Roger	Dodd	The Institute of Cancer Research		Biomedical - trace metal analysis of protein samples
Rob	Edgecock	STFC	Rutherford appleton Laboratory	Radiotherapy using ion beams. Radiation damage to heavy elements
Jonathan	England	Varian Semiconductor Equipment Associates Inc.		Ion Implantation, Ion Accelerators, Plasma Surface Interactions
Jan	Evans-Freeman	Sheffield Hallam University	Materials and Engineering Research Institute	Semiconductors
Patrick	Fairclough	University of Sheffield	Department of Chemistry	Polymers, synthetic and natural Block copolymers, cellulose, polymer gels and networks, surfaces
Giselle	Flaccavento	University of Oxford	Department of Engineering Science & Gray Institute for Radiation Oncology & Biology	Radiation Damage
Kristel	Fobelets	Imperial College London	Department of Electrical and Electronic Engineering	Micro and nanoelectronics
Frederic	Gardes	University of Surrey	Advanced Technology Institute	Silicon photonics active devices
Elspeth	Garman	University of Oxford	Department of Biochemistry	Biomedical / protein trace element analysis/cell imaging and elemental analysis
William	Gillin	University of london	Department of Physics	Organic electronics, photonics and spintronics
Michael	Gray Campana	University of Cambridge		Cultural heritage. Biological research. Archaeological research. Historical materials research.
Geoff	Grime	University of Surrey	Ion Beam Centre	Nanobeam design, PIXE, external beams
Russell	Gwilliam	University of Surrey	Ion Beam Centre	Application of Ion Beams to Microelctronic and photonic devices. Ion Beam machines
Matthew	Halsall	The University of Manchester	School of Electrical and Electronic Engineering	Microelectronics, sensors, optoelectronics
Suhairul	Hashim	University of Surrey	Department of Physics	Biomedical applications
D G	Hasko	University of Cambridge	Department of Engineering	Micro-and nanoelectronics Vacuum microelectronics Quantum information
William	Headley	University of	Advanced Technology	Microelectronics, optoelectronics, metrology,

		Surrey	Institute	silicon photonics
Matthew	Healey	Cranfield University	Defence Academy of the United Kingdom	Ion beam analysis, fusion energy materials, electronic materials
Jonathan	Hinks	University of Salford	Institute for Materials Research	Transmission electron microscopy with in situ ion irradiation. Radiation damage of materials
D E	Hole	University of Sussex	Engineering and Design	Implantation of Insulators, Fusion Materials
Andrew	Holmes-Siedle	University of Brunel	Department of Physics	Radiation damage, simulation of fusion conditions, space reliability
Kevin	Homewood	University of Surrey	Ion Beam Centre	Silicon photonics
Alton	Horsfall	Newcastle University	School of Electrical, Electronic and Computer Engineering	Microelectronics
Kieren	Howard	Impacts and Astromaterials Research Centre (IARC)	Department of Mineralogy, Natural History Museum	Geology - Meteorites and Meteorite Impact
Chris	Howe	University of Cambridge	Biochemistry	Biomedical analysis of ancient documents, photosynthesis
Zhirun	Hu	University of Manchester	School of Electrical & Electronic Engineering	Microelectronics, MMICs, metamaterials for millimetre & THz applications
Paul	Huggett	University of Newcastle	INEX	Wide Bandgap Microelectronics, MEMS
Nigel	Hussey	University of Bristol	H.H. Wills Physics Laboratory	Correlated electron systems Unconventional superconductivity Disorder / localization studies
Neil	Hyatt	University of Sheffield	Department of Engineering Materials	Understanding the mechanism of radiation damage in nuclear waste glasses and ceramics, and the impact on long term performance (e.g. volume swelling, aqueous durability) in various disposal scenarios. Use of ion implantation to simulate alpha-recoil damage nuclear waste ceramics and glasses, as an inactive analogue for actinide alpha-decay.
Raj	Jena	Addenbrooke's Hospital	Oncology Centre	Radiation biology: assessment of tumour cell in vitro radiosensitivity with charged particle beams
Mike L	Jenkins	University of Oxford	Department of Materials	Radiation damage, development of structural materials for future fusion and fission power reactors
Jonathan	Jeynes	University of Surrey	Ion Beam Centre	Biomedical application of ion beams
Chris	Jeynes	University of	Ion Beam Centre	Ion Implantation, ion beam analysis including accurate and traceable IBA with code

		Surrey		developments
Bleddyn	Jones	University of Oxford	Institute for Radiation Oncology and Biology	Radiation Biology and clinical Cancer Therapy
Brian	Jones	University of Surrey	Ion Beam Centre	PIXE, RBS, SIMS. Materials analysis, molecular imaging
Keith	Jones	Merseyside Police	Major Incident Team	Exhibits officer with Merseyside Police's Major Accident Team (Cat A and B murder investigations). Forensics
Ravin	Jugdaohsingh	Elsie Widdowson Laboratory	MRC Human Nutrition Research	Biomedical applications
Andrezej	Kacperek	Clatterbridge Centre for Oncology		Radiobiology of clinical proton and ion beams. Proton beam measurements (dose, fluence) and study of high ionisation-density effects at Bragg peak and radiation damage. Dosimetry standards for ion beams.
Anton	Kearsley	Natural History Museum	Department of Mineralogy	Extraterrestrial materials, samples returned by spacecraft, damage to spacecraft in orbit, cometary dust, meteorites, mineralogy generally, microanalysis applications across the natural sciences
Hamid	Kheyrandish	CERAM Ltd		Thin films , microelectronics , radiation damage nano materials
Karen	Kirkby	University of Surrey	Ion Beam Centre	Application of ion beams to biomedicine and electronic materials
Norman	Kirkby	University of Surrey	Chemical & Process Engineering	Mathematical modelling in radio-biology and radio-therapy
Paul	Knox	Consultant	Dorchester	Medical Engineering
Penelope	Lane	QinetiQ	Malvern Technology Centre	Microelectronics
Conrad	Langton	Oxsensis Ltd.	Rutherford appleton Laboratory	Integrated Optics, Microelectronics
Adrian	Leyland	The University of Sheffield	Department of Engineering Materials	Surface Engineering; Coatings Tribology; Materials Physics
Libing	Li	Imperial College London	Department of Materials	Surface analysis, semiconductors, SIMS
Annika	Lohstroh	University of Surrey	Department of Physics	radiation detection materials, wide band gap semiconductors, charge transport properties in solids crystal defects and impurities radiation damage
Manon	Lourenco	University of Surrey	Ion Beam Centre	Silicon photonics
Ewan	Maddrell	National Nuclear Laboratory		Development of wasteforms for nuclear waste disposal. Such wasteforms are often subjected to high levels of alpha decay damage. Ion

				beam irradiation of candidate wasteforms provides a valuable means of assessing their response to alpha decay damage.
Emmanuelle	Marquis	Oxford University	Department of Materials	phase transformations, alloy structures, high resolution analytical techniques.
John	Marsh	University of Glasgow	Department of Electronics and EE	Optoelectronics
Peter	Mason	Cutty Sark Conservation Project	-	Cultural heritage, conservation of historic materials
Phil	Mawby	University of Warwick	School of Engineering	Microelectronics
David	McPhail	Imperial College	The Materials Department	Research Interests: Surface Analysis, Thin Films and Multi-layers, Electronic Materials, Cultural Heritage Materials
Mike	Merchant	University of Surrey	Ion Beam Centre	Nanobeam design and biomedical applications of ion beams
Andrea	Mica	Consultant to the Royal Society		Nanotechnology, materials, energy
Thomas	Miller	The Nottingham Trent University	School of Science & Technology	Phosphorescent materials used within neutron detection within neutron diffraction analysis.
Bill	Milne	University of Cambridge	Electronic Engineering Division CUED	Nanotechnology, Large area electronics
Prashant	Mistry	National Instruments		Proton Beam Writing, Lithography, Biomedical, Microelectronics, Cultural Heritage, Radiation Damage, Geology, Ion Bram Analysis
Gunter	Moebus	University of Sheffield	Dept Engineering Materials	Nanopatterning, nanoparticle generation; membrane modulated ion implantation; generation of nanoscale plasmonic and magnetic structures ion implantation to simulate radioactive damage ion implantation for nanoscale materials science (beyond semiconductors)
George	Monger	George Monger Conservation and Museum Services	Suffolk	Cultural Heritage conservation
Ruth	Morgan	UCL JDI		Forensic geosciences
Gavin	Morley	University College London	Department of Physics and Astronomy	Quantum information and spintronics of dopants in silicon with pulsed electron spin resonance.
Chris	Moynehan	LGC Forensics		Forensic science; specifically gunshot residues and the use of ion beams to improve discrimination between samples from different sources

David	Neely	STFC, Rutherford Appleton Laboratory	Central Laser Facility	Radiation damage and temporal effects
Tim	Noakes	Daresbury Laboratory		Medium Energy Ion Scattering
Anthony	O'Neil	Newcastle University	School of Electrical, Electronic and Computer Engineering	Microelectronics
Vladimir	Palitsin	University of Surrey	Ion Beam Centre	Nanobeam design
Greg	Parker	The University of Southampton	Electronic Engineering	Microelectronics & Optoelectronics
Gaurang	Patel	Queens University Belfast	Centre for Cancer Research & Cell Biology	Radiation damage and bystander effects.
Luca	Pellegrini	University of Cambridge	Department of Biochemistry	Biomedical
Yong	Peng	Sheffield University	Department of Engineering Materials	Nanorobotics, nanotesting, Nanomaterials
Nianhua	Peng	University of Surrey	Ion Beam Centre	Functional ceramics, ferromagnetic semiconductor, high temperature superconductivity
Carole	Perry	Nottingham Trent University	School of Science and Technology	Biomaterials, biomineralization, bio/chemistry interface, minerals
Jonathan	Pickard	Oclaro (formerly Bookham)	Caswell Office	Opto-electronics
Allam	Pidduck	QinetiQ		Semiconductors, Nanomaterials. Measurement & characterisation
Simon	Pimblott	The University of Manchester	School of Chemistry	Radiation effects on materials Radiation chemistry Nuclear waste
Frank	Placido	University of the West of Scotland	Thin Film Centre	Thin film coatings: deposition, characterisation and applications
Ehmke	Pohl	Durham University	Department of Chemistry	Reader in protein crystallography interested in metalloproteins
David	Pyle	University of Oxford	Dept of Earth Sciences	Environmental particles, esp. particles emitted from volcanoes.
Graham	Reed	University of Surrey	ATI	Ion implantation and Analysis
Morgiane	Richard	University of Aberdeen	Institute of Medical Science	Theoretical biology, mathematical modelling, biophysics, radiation damage in eukaryotic and prokaryotic cells, low dose radiation effects, single-cell radiation effects

Steve	Roberts	University of Oxford	Department Materials	Radiation damage
Kai	Rothkamm	Health Protection Agency	Centre for Radiation	Radiation protection Radiation-induced DNA damage & repair Non-targeted effects of radiation
Ben	Royall	University of Essex		Solar Cells
Ray	Rutherford	Surrey Police HQ		Forensic, Investigative and Operational Support
David	Sands	University of Hull	Dept Physical Sciences	microelectronics radiation damage
Guosheng	Shao	University of Bolton	CMRI	ion implantation to modify metal oxide semiconductors; ion beam mixing; ion beam synthesis
Richard	Sharp	Isotron Ltd		Radiation effects, semiconductor processing.
A J	Simons	OinetiQ	Malvern Technology Centre	Material nano-metrology. Secondary Ion Mass Spectroscopy
Peter	Skeldon	University of Manchester	School of Materials	Materials science, films and coatings, surface engineering, oxide growth, protection and functionalization of metal surfaces
Maurice	Skolnick	University of Sheffield		Co-Director III-V Facility
Andy	Smith	University of Surrey	Ion Beam Centre	Ion Implantation and semiconductor devices, shallow doping
George	Smith	Oxford University	Department of Materials	Physical metallurgy. Materials characterisation. Atom probe microanalysis
Roger	Smith	University of Loughborough	Department of Mathematical Sciences	Damage and sputtering
Carl	Sofield	Independent Consultant		Nuclear Physics, Ion Beam Analysis, Application of MeV Ion Beams
Will	Stanley	University of Western Australia	ARC CoE Plant Energy Biology	Structure and function of proteins of biomedical and biotechnological significance.
John	Steeds	University of Bristol	Physics Department	Radiation damage of wide band-gap semicondutors and SiC/SiC composites
Martin	Stennett	University of Sheffield	Engineering Materials	Simulation of radiation damage in ceramics and glasses for radionuclide immobilisation
Dave	Sykes	LSA ltd		Chemical Metrology, Semiconductors/Microelectronics
Florian	Tauser	Coherent Scotland Ltd.	West of Scotland Science Park	Semiconductors, ultrafast processes
Alex	Theodosiou	Cardiff University		Radiation damage of high energy ions into a nuclear grade graphite with emphasis on the

				generation of stored energy as a result of atomic dislocations.
Richard	Thompson	Durham University	Department of Chemistry	Polymers, elemental analysis for range of applications
Michael	Thompson	Retired		Ion Surface interactions, sputtering
David	Thomson	University of Surrey	Advanced Technology Institute	Optoelectronics
Claire	Timlin	Oxford University		Particle therapy cancer research
David J.	Timson	Queen's University of Belfast	School of Biological Sciences	Radiation damage to biomolecules
Takashi	Uchino	University of Southampton	School of Electronics & Computer Science	Microelectronics
Marta	Ugarte	University of Manchester		Biomedical, retinal physiology, retinal pathology, trace element homeostasis in retinal disease
Jaap	Van den Berg	University of Salford	School of Computing, Science and Engineering	Low energy ion implantation; shallow damage formation and annealing; high depth resolution ion beam analysis
David	Vaux	University of Oxford	Sir William Dunn School of Pathology	Elemental analysis in biomedical samples Metal ion effects on amyloid oligomer assembly
Tim	Veal	University of Warwick	Department of Physics	Semiconductor physics
John	Vickerman	The University of Manchester	Manchester Interdisciplinary Biocentre School of Chemical Engineering and Analytical Science	Fundamentals of polyatomic ion beam interactions with organic materials, biomaterial analysis, instrumental developments in ion beam analysis
Vladimir	Vishnyakov	MMU	Surface Coatings and Characterisation Group	Surface Coatings, Ion Beam Assisted Deposition, surface characterisation
Borivoj	Vojnovic	University of Oxford	Institute for Radiation Oncology and Biology	Biomedical, biological radiation damage, biological cell signaling processes
Paul	Warburton	University College London	London Centre for Nanotechnology	Nanoelectronic devices
Neil	Ward	University of Surrey	Dept of Chemistry	Forensic Chemistry and Environmental Chemistry
John	Watts	University of Surrey	Surrey Materials Institute and Faculty of Engineering & Physical Sciences	Materials science and materials analysis
Roger	Webb	University of Surrey	Ion Beam Centre	MeV SIMS,scanning in air molecular analysis, sputtering phenomena, interaction of ions and

				clusters with surfaces
Keith	Welham	e2v Technologies Ltd		Materials Analysis
Terry	William	Natural History Museum	Department of Mineralogy	Earth sciences, Biomineralization
Peter	Williams	Oclaro (formerly Bookham)	Caswell Office	Optoelectronics
Joe	Woodford	National Instruments		Accelerator measurement technology and diagnostics
Paul	Wyeth	University of Southampton	Textile Conservation Centre	Cultural Heritage: textile conservation science - materials characterisation for informed preservation, display and interpretation.