

# Postgraduate Radiation Protection Training & Needs: The University of Surrey Model

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**THE GAME 24 PAGES OF PURE FOOTBALL EVERYKICKEVERYGOAL**  
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## Desperate housekeeping

TIPS FROM THE 1950s times?

### Britain is ready to go nuclear

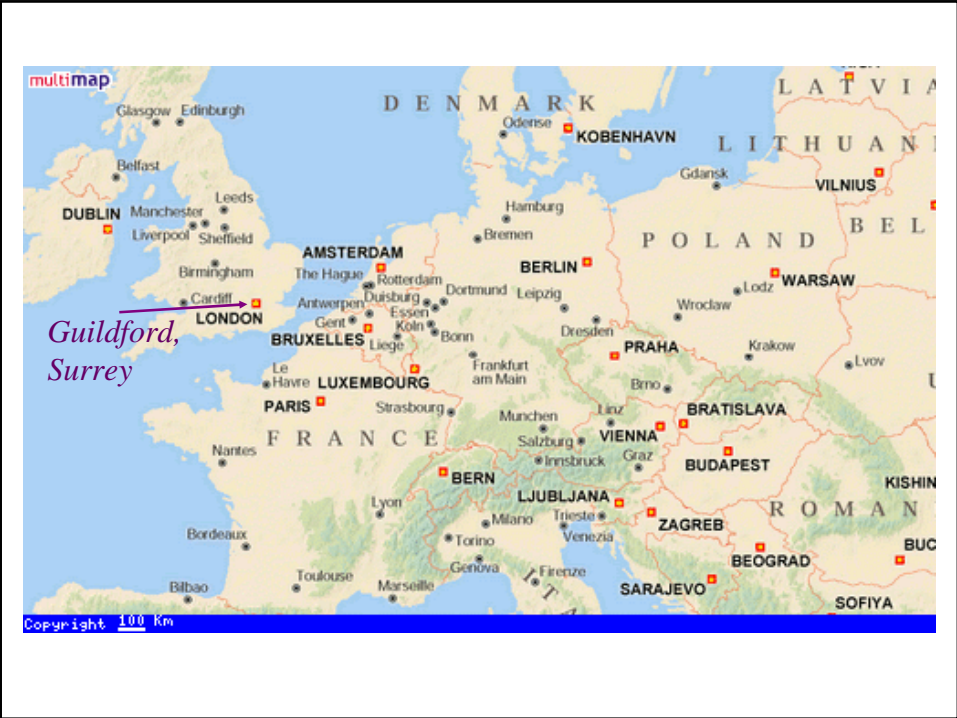
Blair courts controversy with power station plan

### Going home: shot WPC mourns her lost friend

### Nuclear power and defence are clearly back on the main UK and International political agenda.

### The international need for well trained staff with expert skills in nuclear science, Engineering and related areas (health physics, materials, computational modelling, etc.) are clear.

### What can we offer at Surrey?



## The University of Surrey

- Established (1891) Battersea Institute of Technology (part University of London).  
Physics started in 1906  
Moved to current site in Guildford in 1968.
- Student numbers (2004)
  - ~7000 undergraduate students (BSc, BA, BEng, MPhys...)
  - ~3600 taught post-graduate (MSc, MBA, MA, etc.),
  - ~1000 research postgraduates (PhD, EngD etc.).
- 7 Academic Schools (groups of departments)
  - Physics in School of Electronics and Physical Sciences (SEPS)
- 2700 total staff, of which 500 are academics.

## Centre for Nuclear and Radiation Physics

15 FTE Academics, 2 Senior Fellows, 1 Emeritus

- Fundamental nuclear physics (experimental and theory),
- novel detector materials and systems,
- x-ray imaging and micro-tomography,
- medical physics and imaging, dosimetry,
- MR imaging and spectroscopy,
- ion-beam analysis,
- nuclear reactions analysis;

£1.4M/annum research and contracts

HMS Sultan (Associated Institution) Reactors, .....

Services taught Postgraduate courses (~60 FTE)

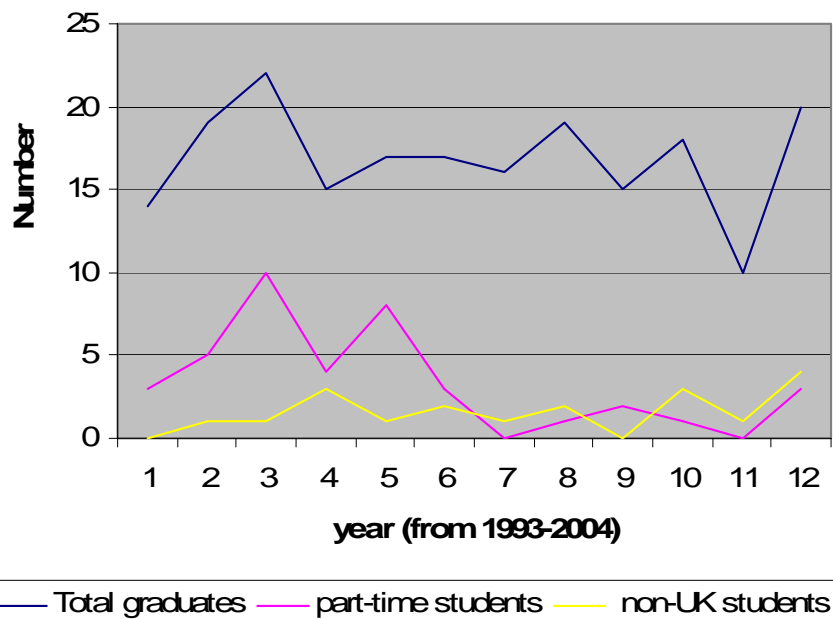
MSc Radiation and Environmental Protection (CTA)

MSc Medical Physics (NHS)

MSc Medical Imaging (taught with Electronics)

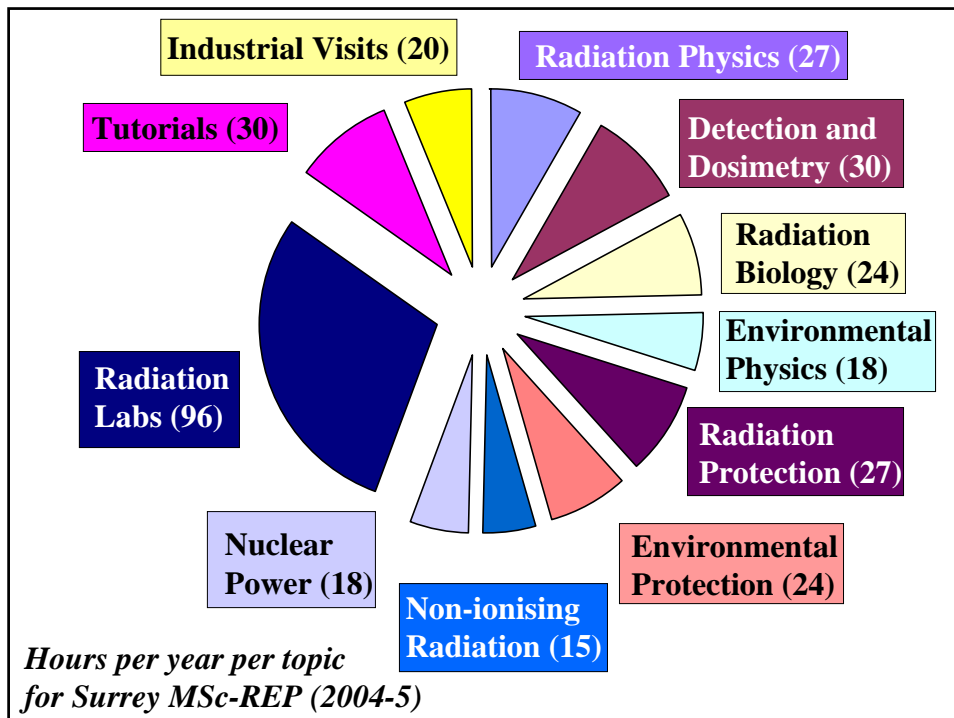
## MSc Course in Radiation & Environmental Protection

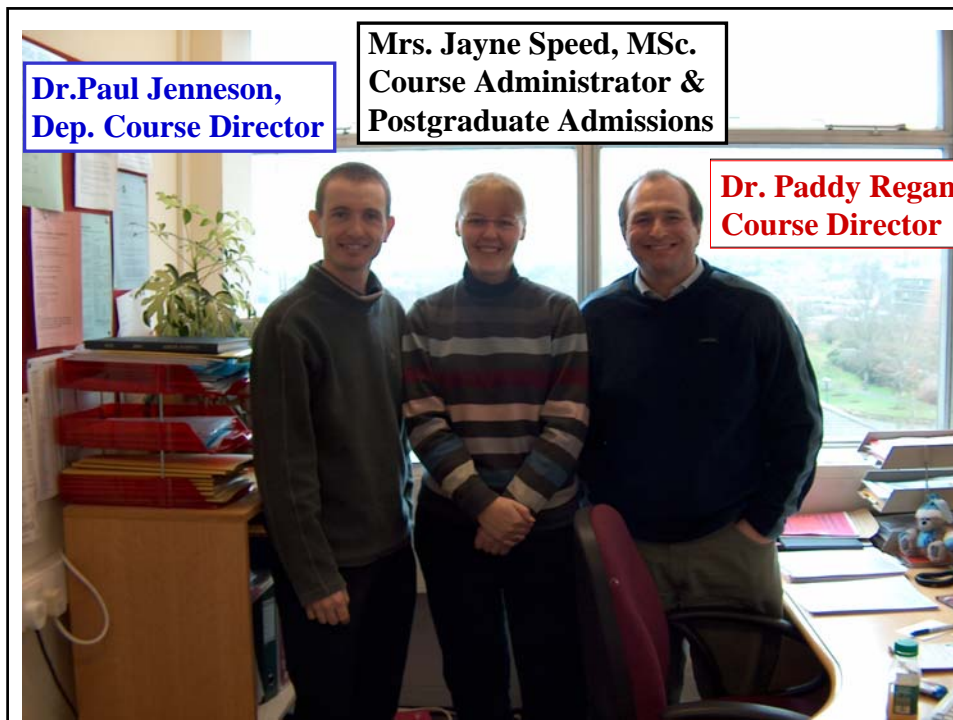
- MSc course has been running at Surrey for >30 years.
- Full time course runs from end of Sept. for 12 months.
  - Formal teaching 10am-5pm Mondays and Thursdays.
  - Tutorial/revision classes Weds. Mornings
- Lectures run over 2 x 15 week semesters (for PGDip)
  - Semester 1: Labs. each afternoon weeks 1-13
  - Semester 2: Extended 5 week project weeks 1-5
- Part-Time Option (for students on work day release)
  - Two-year period, fits into standard full time table
- MSc research thesis (3 month project) after exams.  
Current MSc course tuition fees (2005): £12.5k (non-EU) ; £3.5k (EU)



## MSc-REP Course Content (2004-5 Session)

- Four Core Topics
  - Radiation Physics (27 hours)
  - Detection and Dosimetry (30 hours)
  - Radiation Biology (24 hours)
  - Environmental Physics (18 hours)
- Four Applications Topics
  - Radiation Protection (27 hours)
  - Environmental Protection (24 hours)
  - Non-ionizing Radiation (15 hours)
  - Nuclear Power (18 hours)
- Laboratories and Presentation Skills
  - Radiation Laboratories (60 hours) + 5 week project (30 hours)  
plus seminar presentation day (6 hours)





## Radiation Laboratory Work

- Students perform 9 scripted experiments on
  - Introduction to Ionizing Radiation
  - Introduction to Gamma-ray Spectroscopy
  - Compton Scattering and Attenuation
  - The Szillard-Chalmers Reaction
  - Ion Exchange Separation of Uranium from Copper
  - Beta Counting and Spectroscopy
  - Alpha Spectroscopy
  - Radioactive Contamination of Surfaces
  - Thermoluminescence Dosimetry
  - Neutron Detection and Spectroscopy
  - X-ray Fluorescence



Students spend significant time (90 hours) in our recently refurbished radiation laboratories.  
Students work in pairs for the 10 week laboratory sessions.



Students can also use the laboratories for their 5 week projects. Extra supervision is given by PhD student demonstrators.



.....and our chief laboratory technician, Dennis Libaert.





Formal lectures are given (in three hour slots) by expert lecturers for each subject. ~10 are Surrey academics and 15 are externals.



Overseas students (e.g. IAEA fellows such as Mafhoudh) are guaranteed University accommodation during their MSc. Year at Surrey. University has ~3500 places for student accommodation.

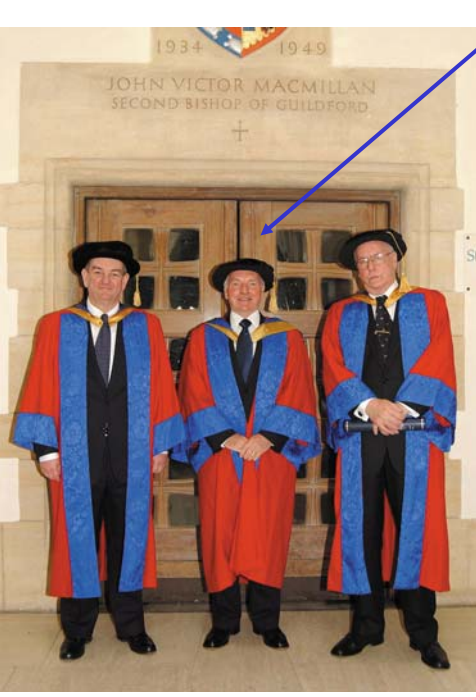


Single rooms are available either on campus (at International House) or off-site (at Hazel Farm)



Other External Expertise includes professional from....

- National Radiological Protection Board (now the HPA)
  - Cellular Radiobiology and Carcinogenesis
  - Electromagnetic Fields
  - Epidemiology
  - Radiation Protection and Ionizing Radiation Regulations
- National Nuclear Corporation (NNC Ltd.)
  - Decommissioning and Waste Disposal
- Royal Surrey County Hospital
  - Medical exposure to radiation and legislation
- Atomic Weapons Establishment, Aldermaston
  - Environmental management and practical env. Protection
- DML Devonport (Naval Dockyard)
  - Practical radiation protection and emergency arrangements
- Specialist Consultants
  - Environmental law and policy; Risk assessment; Distribution of radionuclides in the environment; exposure to EM fields....



Prof. Roger Clarke,  
Chair of the International  
Commission on Radiation  
Protection (ICRP).

Prof Clark is a former  
External examiner on the  
REP course. He currently  
teaches radiation protection.  
He is a visiting Professor at  
Surrey and was awarded an  
Honorary Doctorate in 2003.

Current external examiner is  
Prof. Roger Cox, Director of  
the UK National Radiological  
Protection Board (now the  
Health Protection Agency).

The application of CdZnTe detectors for coincident  $\alpha$ - $\gamma$  spectroscopy

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 Department of Physics, University of Surrey, Guildford GU2 7XH, UK  
 Received 25 September 2000; accepted 12 October 2000

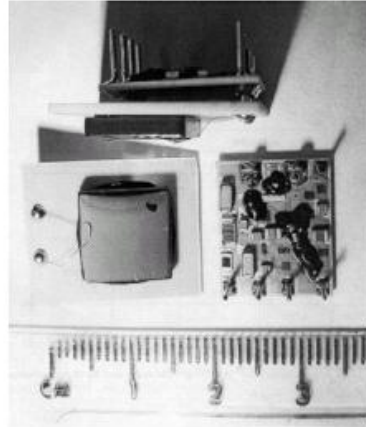


Fig. 1. CdZnTe detector and hybrid preamplifier used in the current work.

3 month dissertation projects are major aspect of final MSc. Subjects have included CZT detector development....

C.J. Pearson et al. / Nuclear Instruments and Methods in Physics Research A 462 (2001) 393–396 395

Table 1  
 Decay information for the  $^{241}\text{Am}$ – $^{209}\text{Pu}$ – $^{244}\text{Cm}$  source used for all measurements

| Isotope           | $\alpha$ -particles |                     | $\gamma$ -rays |                     |
|-------------------|---------------------|---------------------|----------------|---------------------|
|                   | Energy (keV)        | Branching ratio (%) | Energy (keV)   | Branching ratio (%) |
| $^{241}\text{Pu}$ | 5306                | 12                  |                |                     |
|                   | 5344                | 15                  |                |                     |
|                   | 5357                | 73                  |                |                     |
| $^{241}\text{Am}$ | 5486                | 85                  | 26.3           | 6                   |
|                   | 5443                | 15                  | 59.5           | 94                  |
| $^{244}\text{Cm}$ | 5762                | 24                  |                |                     |
|                   | 5805                | 76                  |                |                     |

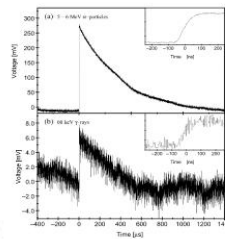


Fig. 3. Representative pre-amplifier signals for (a)  $\alpha$ -particles; (b)  $\gamma$ -rays. The insets show the rising part of the signals.

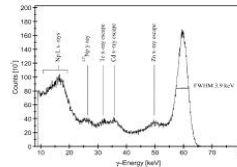


Fig. 4. Spectrum of  $\gamma$ /X-rays from the mixed source.

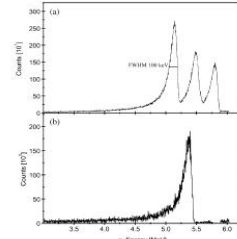
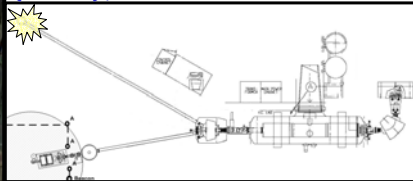


Fig. 5. Spectrum of  $\alpha$ -particles from mixed source (a) ungated; (b) in coincidence with 60 keV  $\gamma$ -ray.



Students can use Surrey Ion Beam Centre (2 MV tandemron machines) for applied project work, such as nuclear reaction analysis (NRA), RBS & PIXE.



**In-beam performance of CdZnTe detectors for proton and alpha-particle measurement**

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Department of Physics, University of Surrey, Guildford GU2 7XH, UK

Received 2 January 2001; received in revised form 24 July 2001; accepted 1 August 2001

**Abstract**

The performance of a CdZnTe detector for measuring charged particles from the reaction of  $^6\text{He}$  has been evaluated at proton and alpha particle energies of approximately 13 and 2 MeV, respectively. The energy resolution observed from this in-beam study highlights the potential of these detectors for use as ancillary detectors for channel selection in nuclear spectroscopy. © 2002 Elsevier Science B.V. All rights reserved.

PACS: 29.40.Wj; 29.30.Fj; 29.30.Kv

**Keywords:** CdZnTe detector; Charged particle detection; In-beam

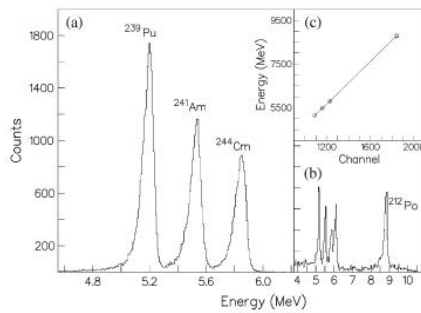
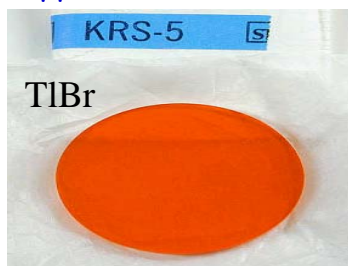


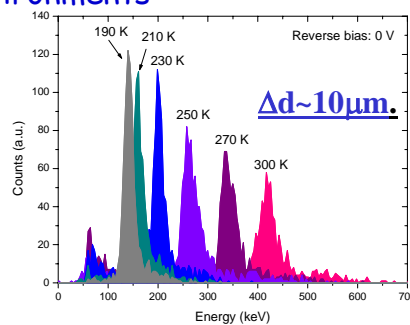
Fig. 3. Energy spectra of in-beam alpha particles and protons, for (a) detector at 120°, beam energy 700 keV, (b) detector at 150°, beam energy 1030 keV, (c) detector at 150°, beam energy 700 keV and (d) detector at 150°, beam energy 400 keV.

Also, projects on development of new semiconductor radiation detectors such as:

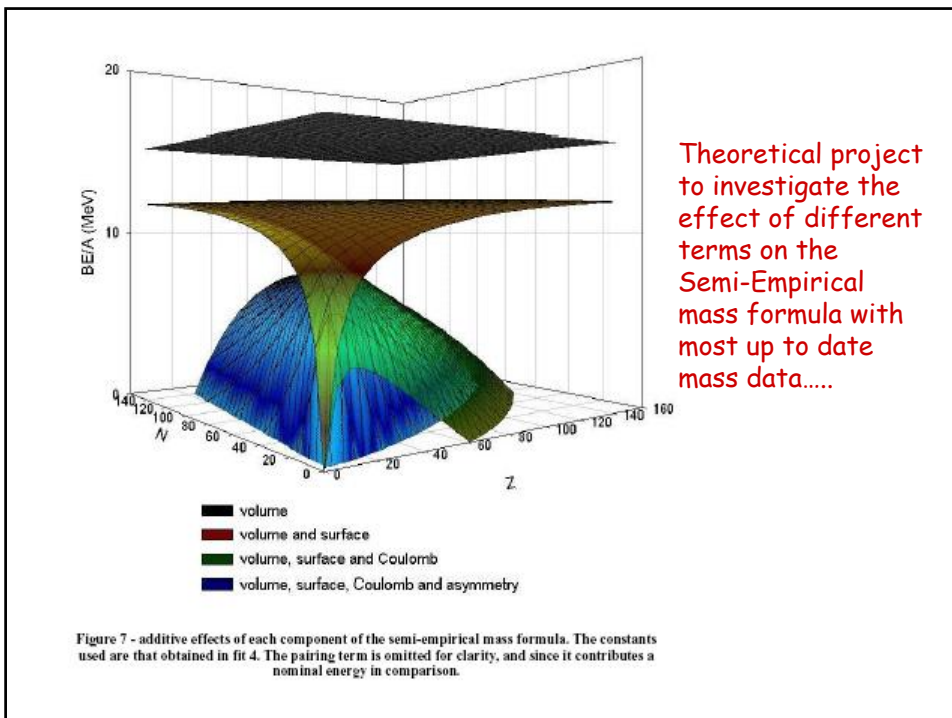
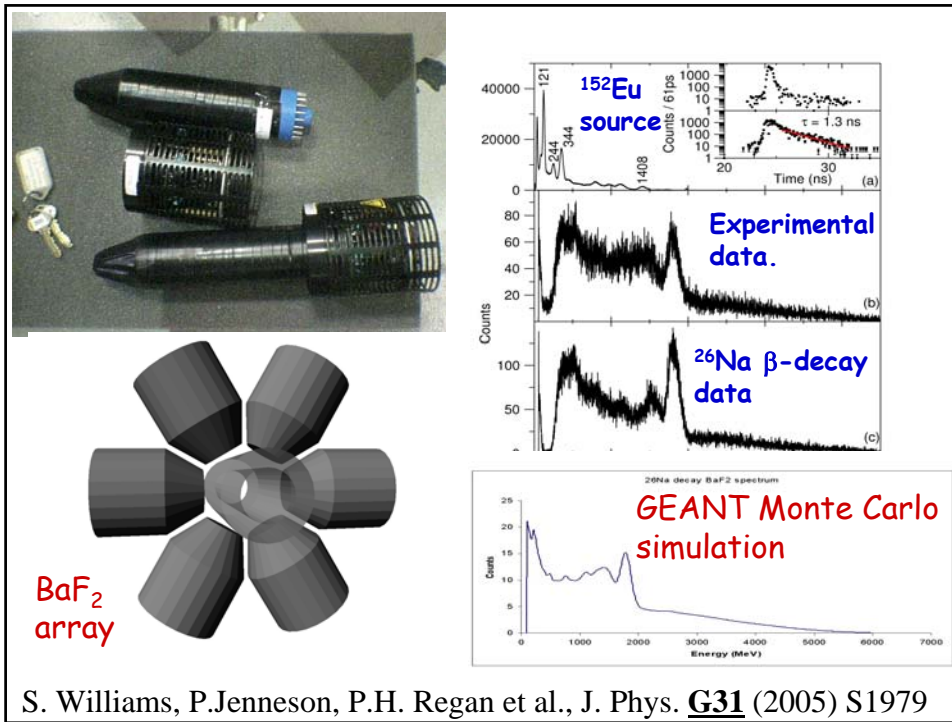
- New high-Z materials for gamma-ray detection such as the 'orange' (TlBr) semiconductor KRS5
- Silicon Carbide  $\alpha$  particle detectors for dosimetry applications in harsh environments



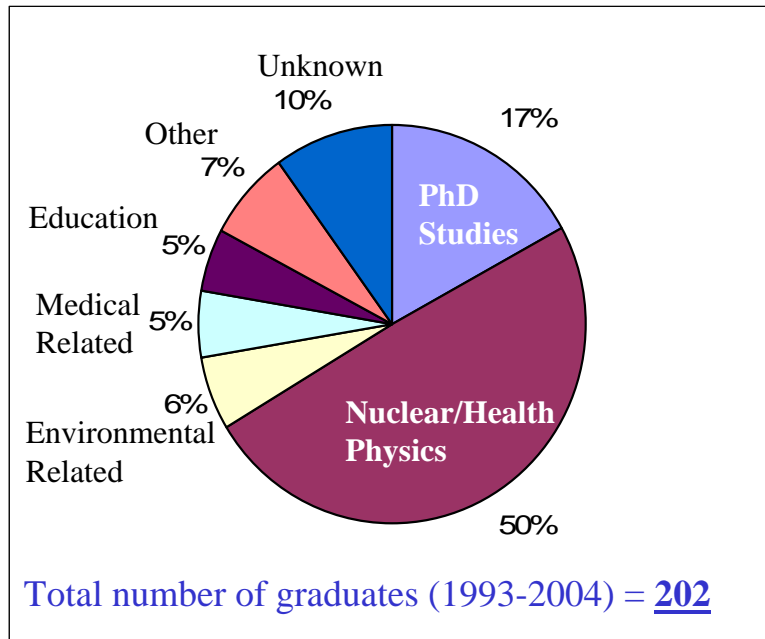
**KRS-5 a new high-Z material for gamma ray detection**



**SiC alpha spectra at zero bias**



### Destinations, Surrey MSc-REP Students (1993-2004)



### Other MSc projects have included.....

- Radiation \ environmental monitoring via
  - gamma-ray spectroscopy and spectrometry.
  - chemical methods (e.g., mass spectroscopy)
- Neutron metrology monitoring.
- Literature reviews on e.g.,
  - Risks for nuclear terrorism.
  - Neutron dosimetry methods.
- Computer simulations/modelling of:
  - New semiconductor materials (electron transport etc.)
  - Biological effects of radiation on cells.
  - Using genetic algorithms to evaluate nuclear masses.
- Nuclear Structure Physics
  - Construction of nuclear energy level schemes for 'exotic' nuclei.
  - Nuclear data evaluation of fission products. etc.

## Summary and Outlook

- Surrey MSc in REP has run for >30 years.
- Full-time, 1 year (or part-time 2 year) course with integrated, three months research project.
- Open to UK, EU and non-EU students.
- Mixture of UK EPSRC-funded scholarships, overseas scholars (e.g., IAEA), UK industrial sponsored (usually part-time) students.
- Looking forward to continuing to provide post-graduate level training for the next generation of Radiation Protection Advisors.