Accelerators at Huddersfield

Roger Barlow

8th April 2016

The IIAA

International Institute for Accelerator Applications

Founded 5 years ago

- 5 Professors
- 3 Research Fellows/postdocs
- 16 PhD students and 2 MSc students

"To teach, research and lead developments in innovative accelerator technology and particle-target interactions, with applications for society in medicine, energy, industry and science"

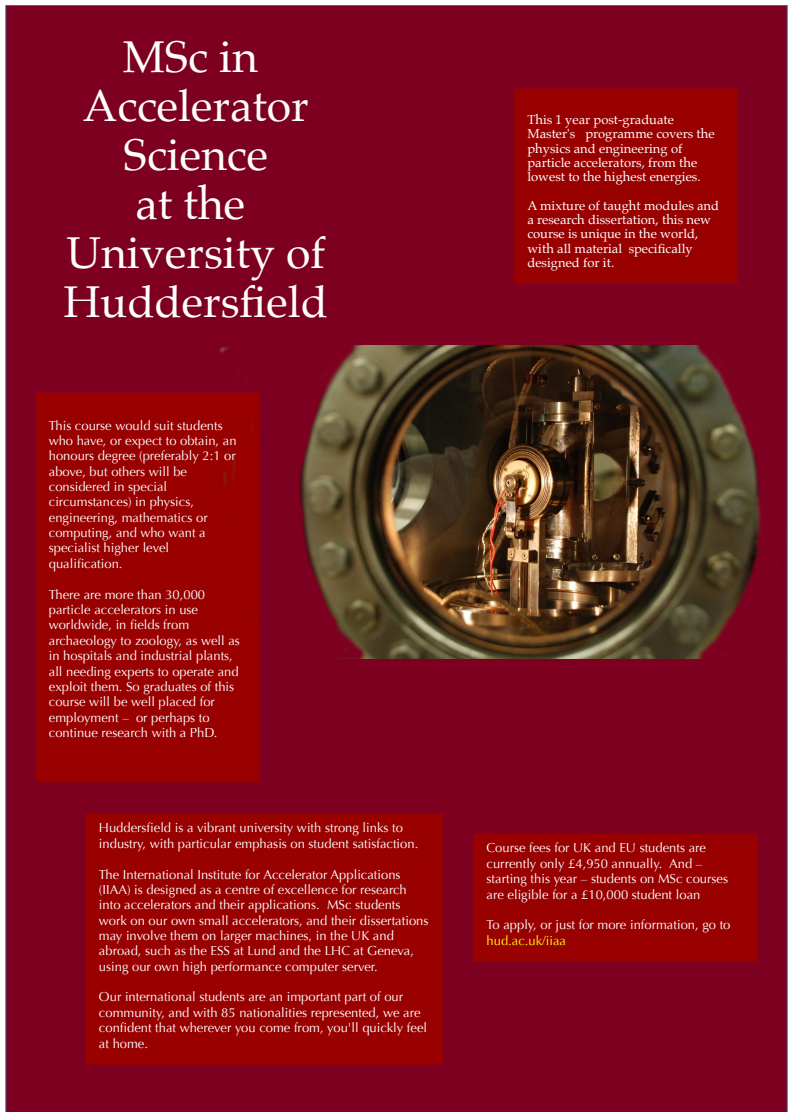
Fundamentals:
University has tradition of strong links with industry
Not competing in areas where established groups are already strong
No undergraduate teaching - pure research institute

MSc course

(Advertisement)

A unique 1 year course in accelerator science - featuring real accelerator codes (MAD, COMSOL, Geant4, LabVIew, etc)

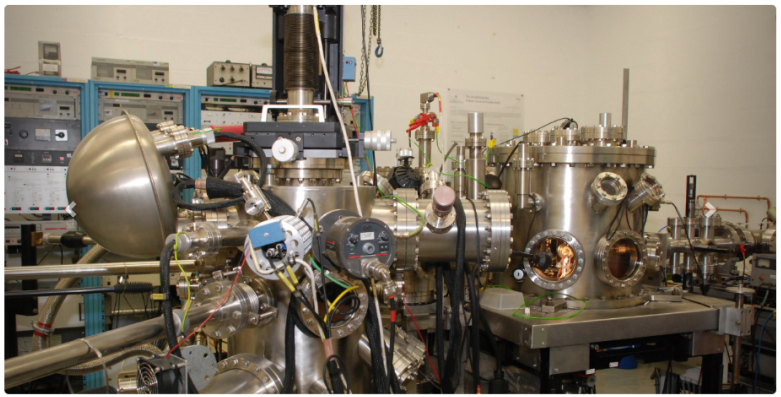
Please take a poster back with you and stick it up where potential students will see it - and recommend it in appropriate cases.
Note: no grants, but students can now get postrgaduate loans - and fees are only £4,950

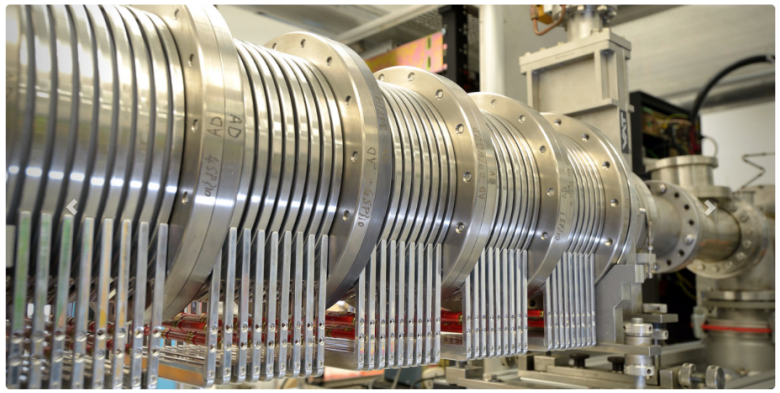


MEIS

Medium Energy Ion Scattering: Jaap van den Berg and Andrew Rossall

200 keV ion source, formerly at Daresbury. Moved across the Pennines and rebuilt+recommissioned

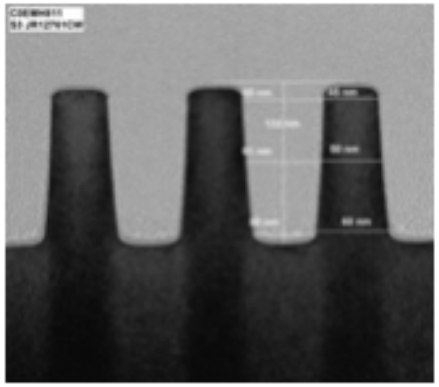




High-rate detector+readout electronics measures energy and angle of scattered ions, yielding information on target nuclei - and their dispositioni in the sample

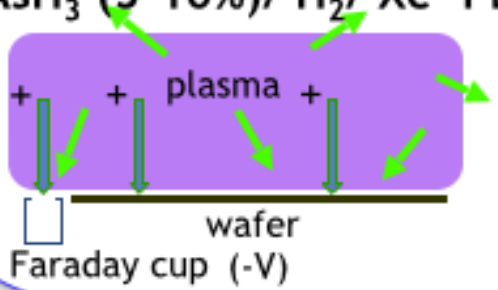
Plasma doping in Si: substitutional As fraction

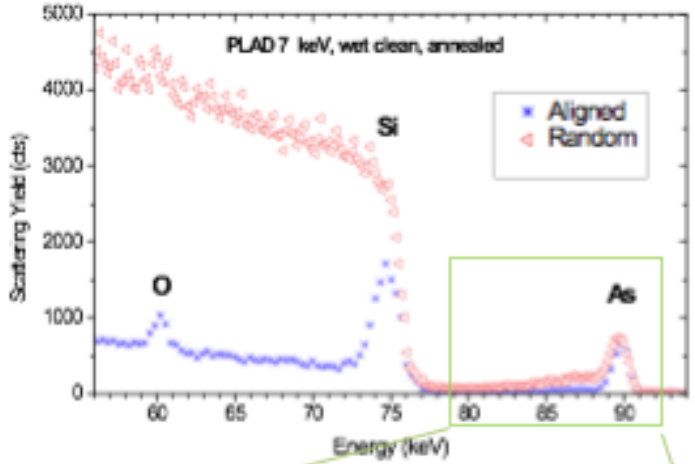
22 nm node transistors
Fin FET transistors

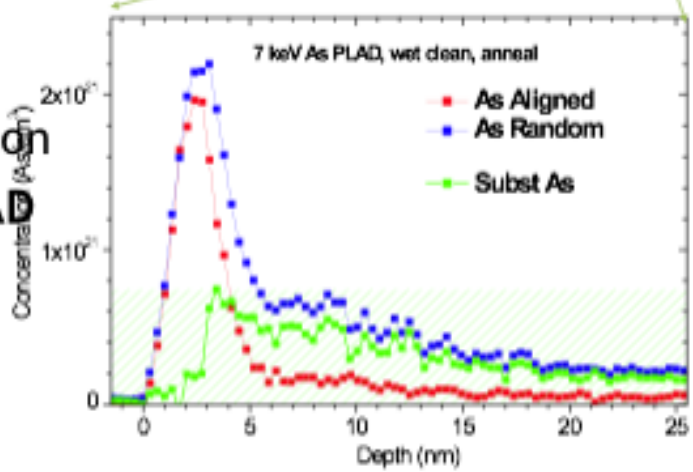


Conformal plasma doping (PLAD) of fins is required
As deposition & Implantation

AsH_3 (5-10%)/ H_2/ Xe PLAD







MEIS spectra using 100 keV He^+ ions

Random & Aligned
[-1-11] in, [112] out

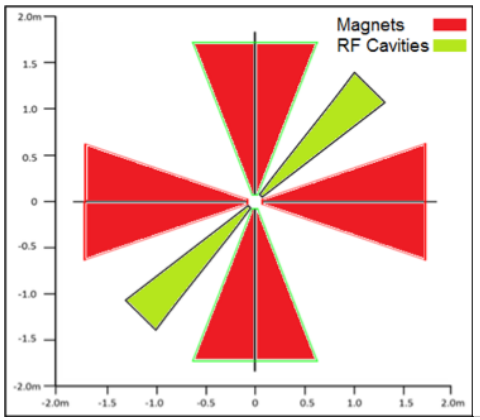
Substitutional As is shadowed in an Aligned spectrum but is "seen" by the ion beam in a Random spectrum

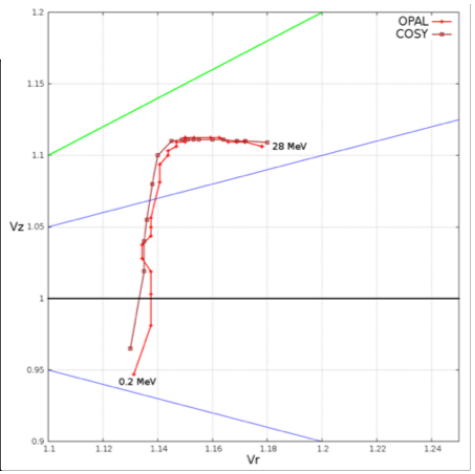
Converted **depth profiles**
As doses:
Random: 1.4 e15 /cm^2
Aligned:6.7 e15 /cm^2
Active As:7.3 e15 /cm^2
Segregated As
4 e15 /cm^2

nsFFAG designs (1) PIP

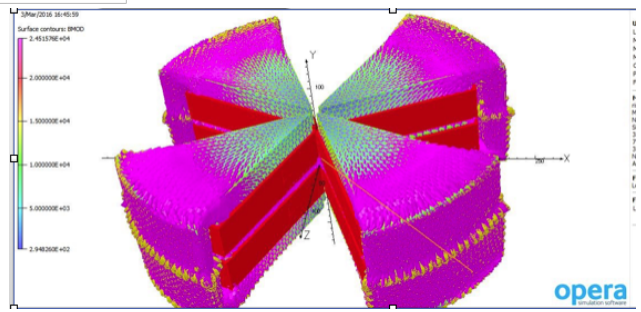
David Bruton, Rob Edgecock, Carol Johnstone

The Proton Isotope Production accelerator A low energy nsFFAG with an internal target - like ERIT, using peaks in cross section to improve efficiency.





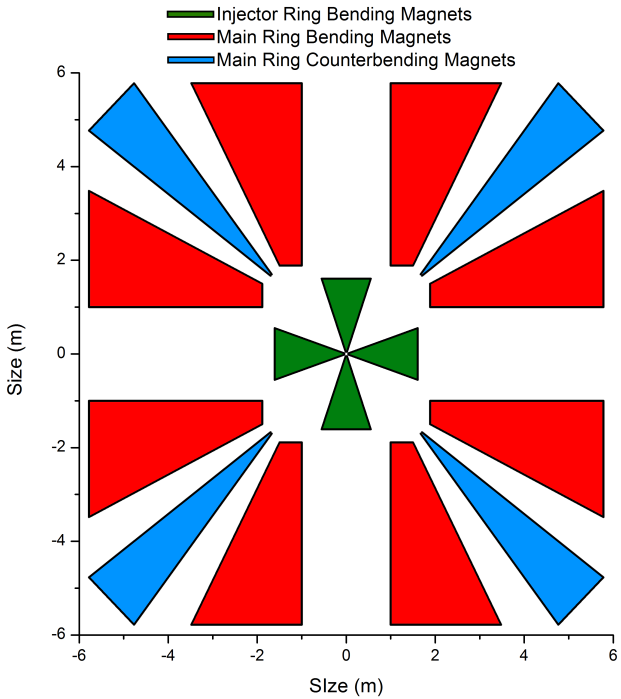
Tunes under control. Magnet design through OPERA has begun This can be built for a few million - logical next FFAG

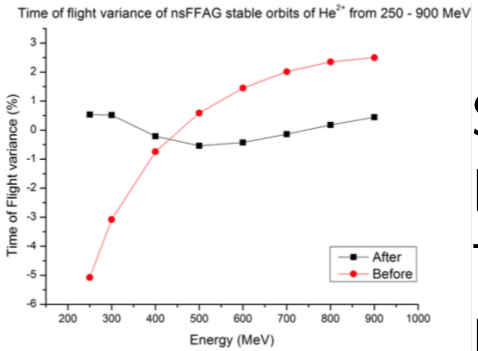


nsFFAG designs (2) - Helium Ion therapy

Jordan Taylor, Rob Edgecock, Carol Johnstone

Heavy Ions look even more promising than protons - massive $\frac{dE}{dx}$ kills cells through double strand breaks. But very difficult for cyclotron/synchrotron.
FFAG looks very promising.
This one has 8 bends, 4 counterbends

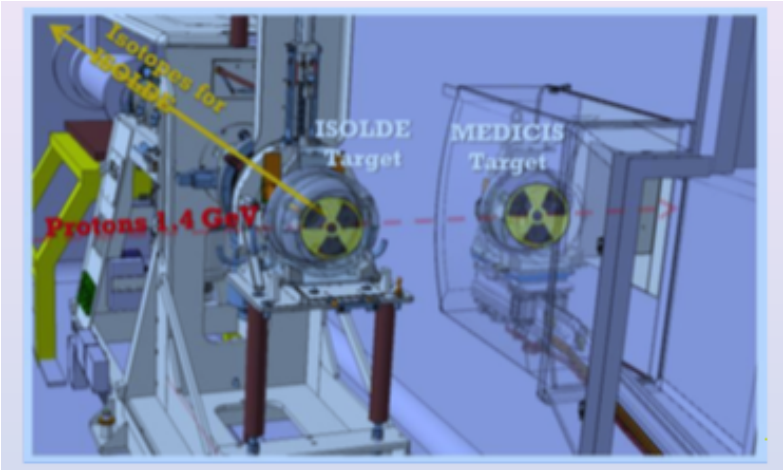




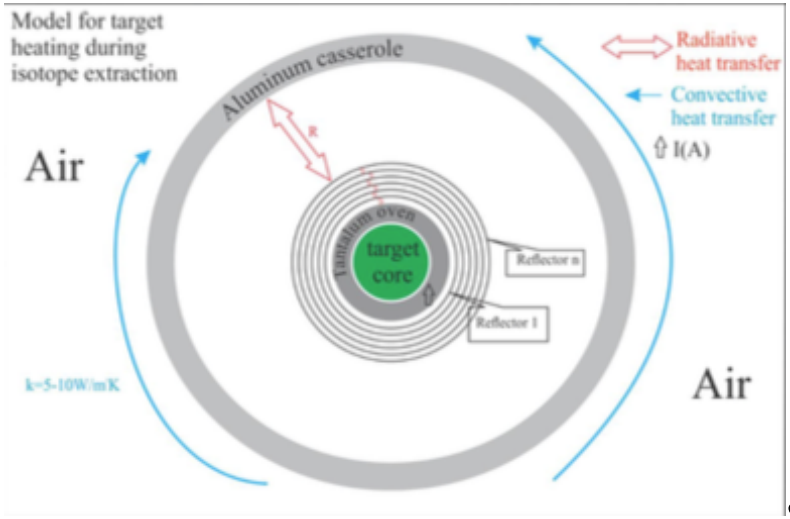
Studies using COSY
Field refined to improve isochronicity
Tunes behave reasonably well
Extraction possible

Isotope production

The MEDICIS project at CERN (Basil Gonsalves)



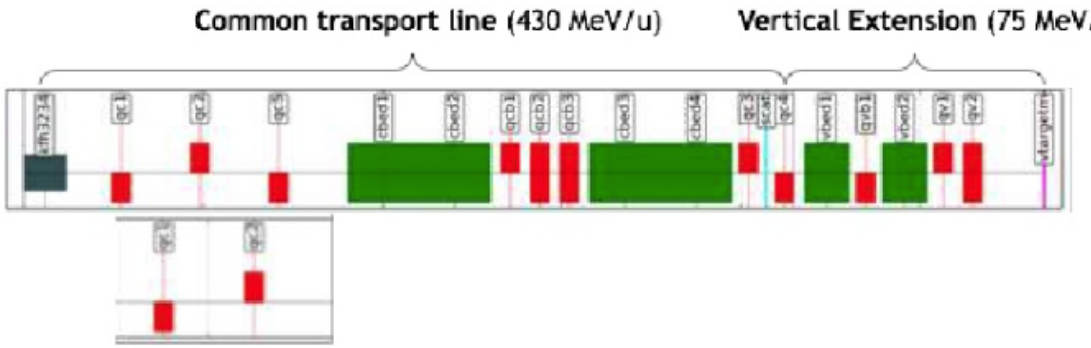
Use the ISOLDE beam for isotope production



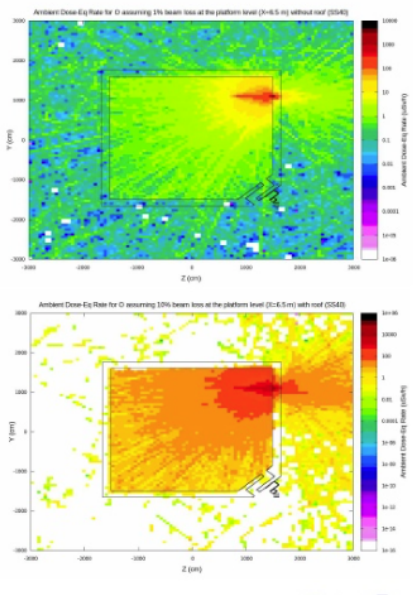
Design oven used to extract useful isotopes from target after irradiation

BioLEIR (Iso known as OpenMED)

(Tanjilul Amin and Roxana Rata)



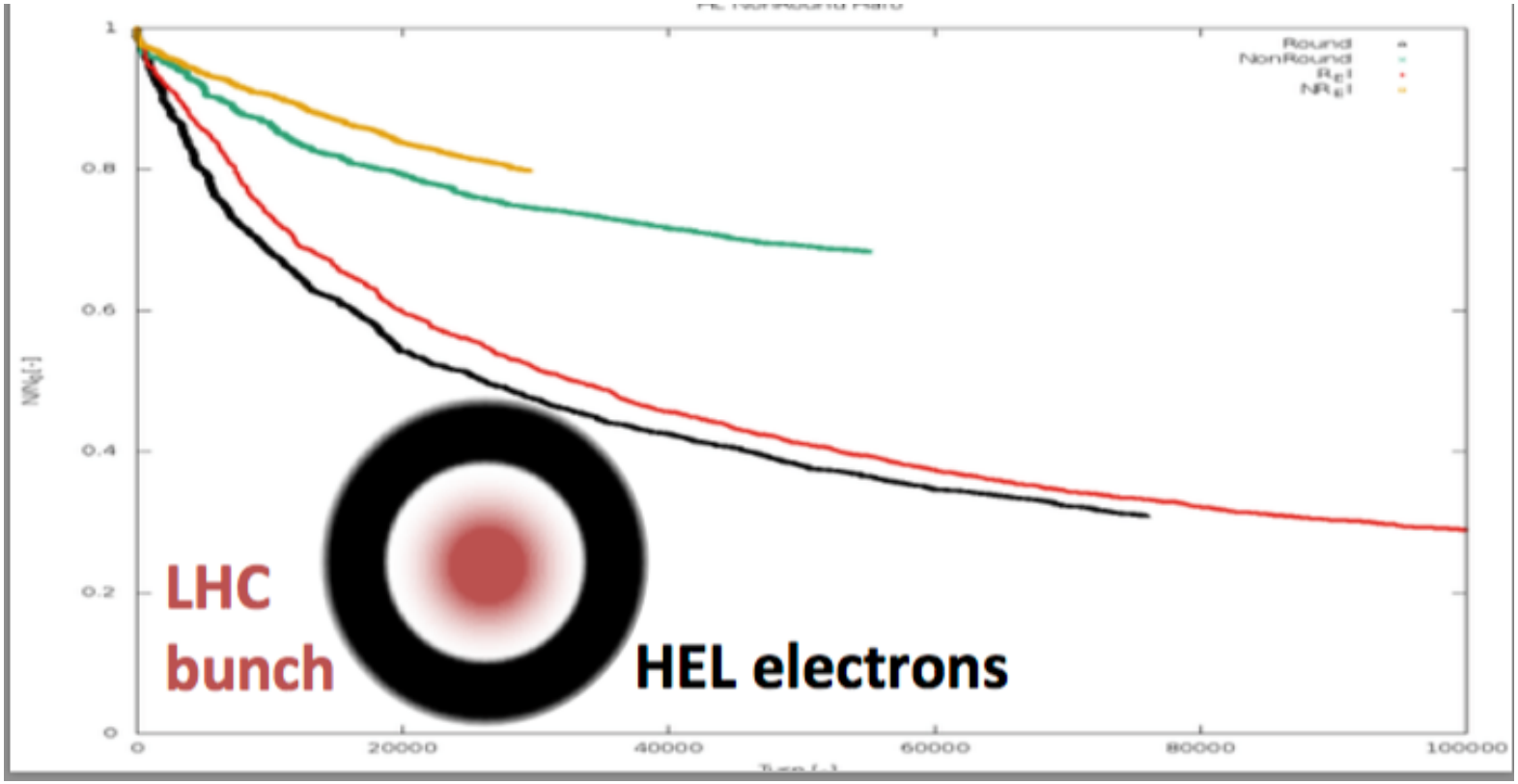
Redesign and optimise extraction line from LEIR



Shielding - what is needed? Can the vertical beam point upwards? Is the CMS control room safe?

Collimation in the LHC

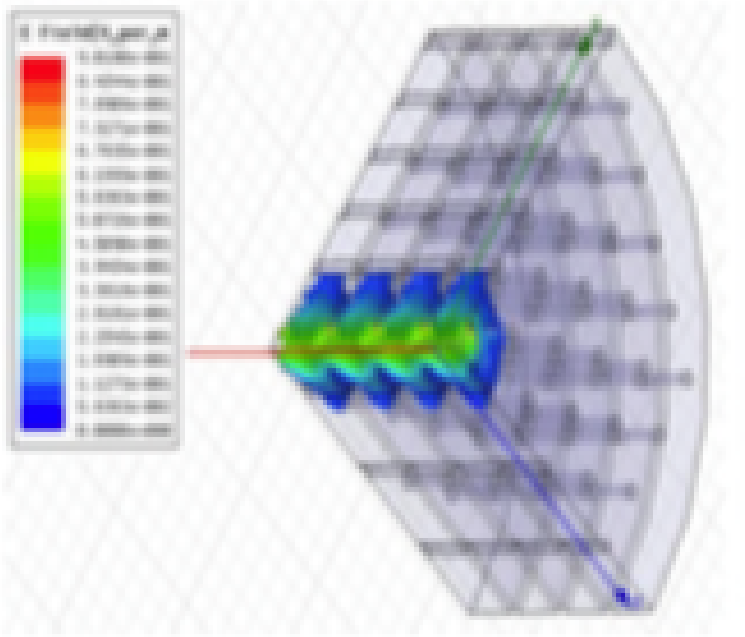
Covered by Rob Appleby's talk

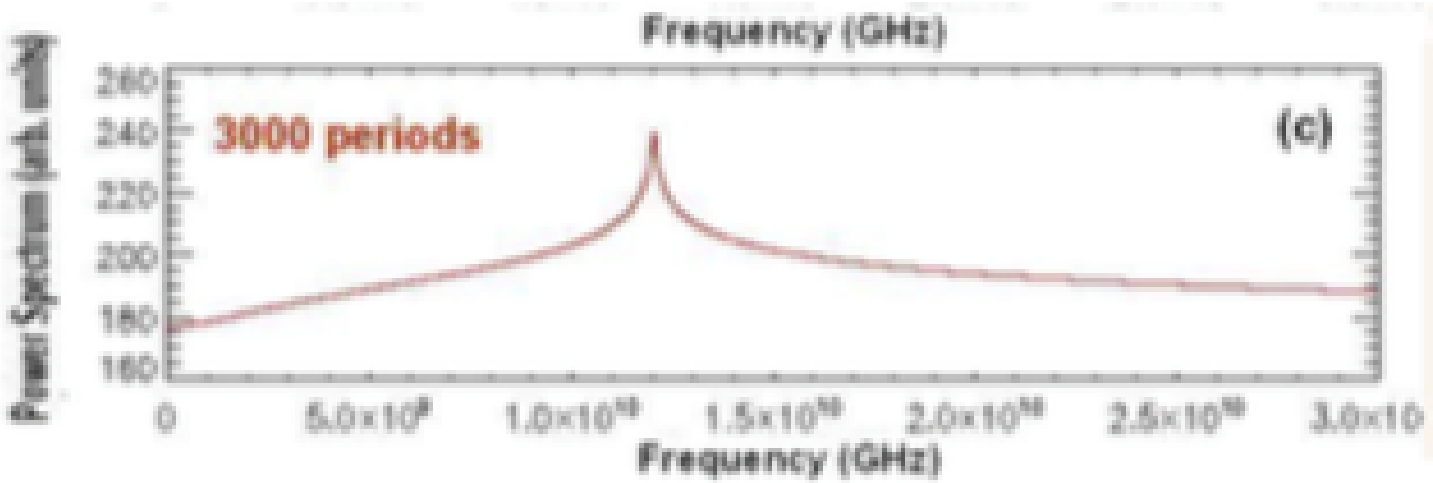


Effect of Hollow Electron Lens collimation (Haroon Rafique)

Novel materials - photonic band gaps

Becky Seviour

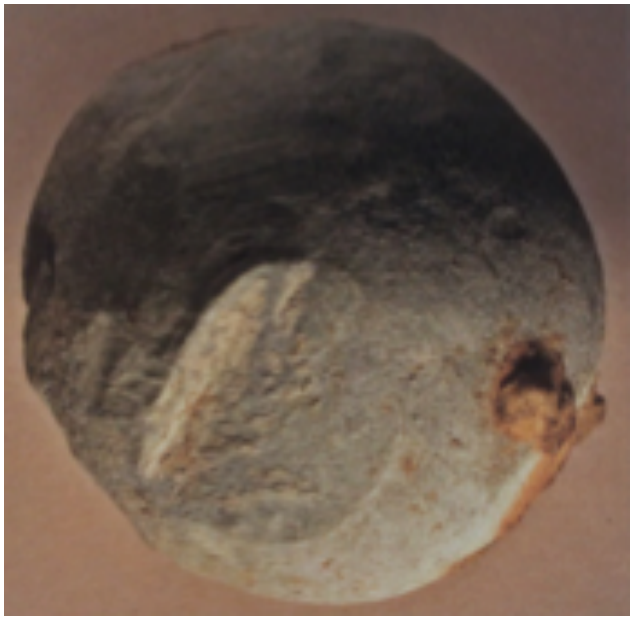




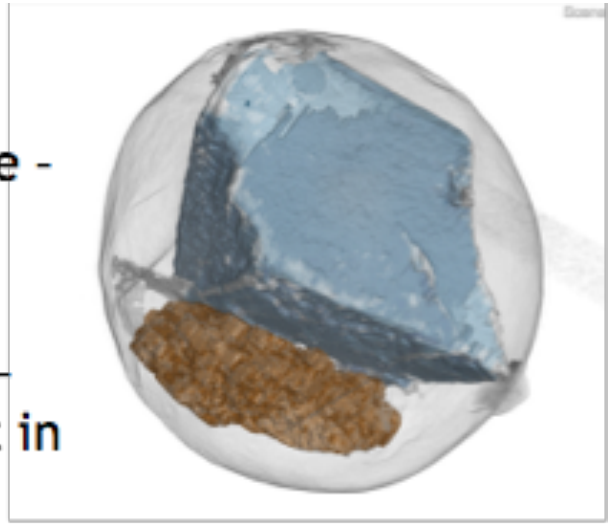
Neutrons as non-destructive probes

Sue Kilcoyne and colleagues

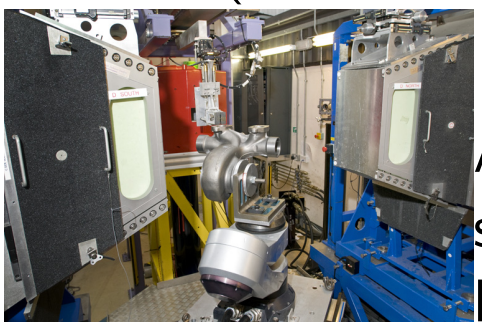
Study cannon shot - Lead is transparent to neutrons
Include chunks of iron. Why???



- Irregular iron cube - roughly chopped from a bar?
- Small stone/flint - intentional or left in mould in error?



This one (from Bosworth Field) has a rock in as well

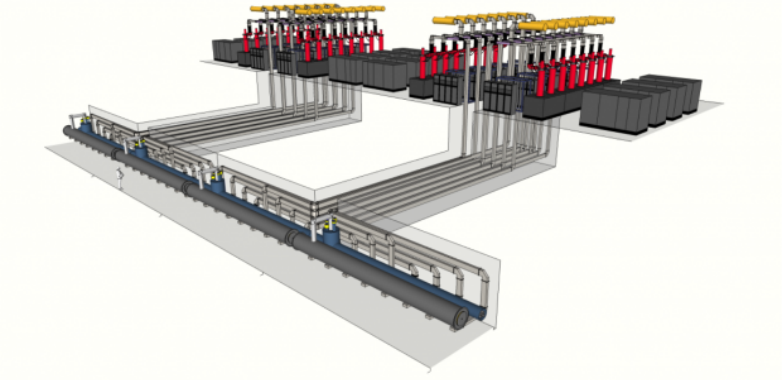


Also use neutrons to study turbocharger housings

The ESS

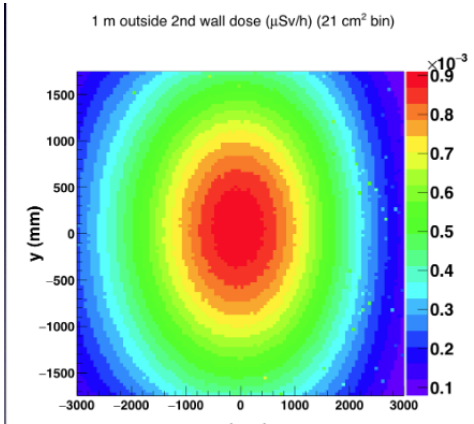
Involved in many ways

Involved from the start (Bob Cywinski) in the campaign to get the ESS built - delighted to see it become real



Responsible for RF distributions system - £23M UK in-kind contribution (Rob Edgecock)

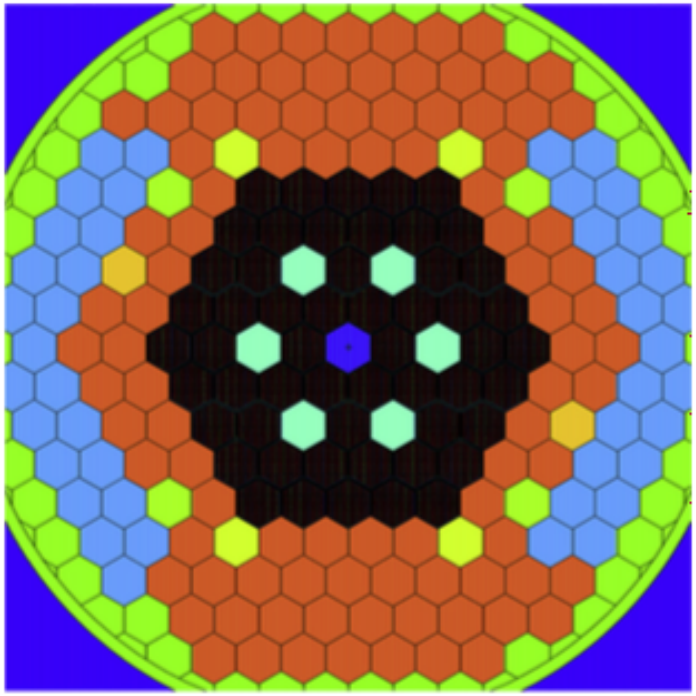
Also shielding calculations using Geant4 (Cristian and Adriana Bungau)

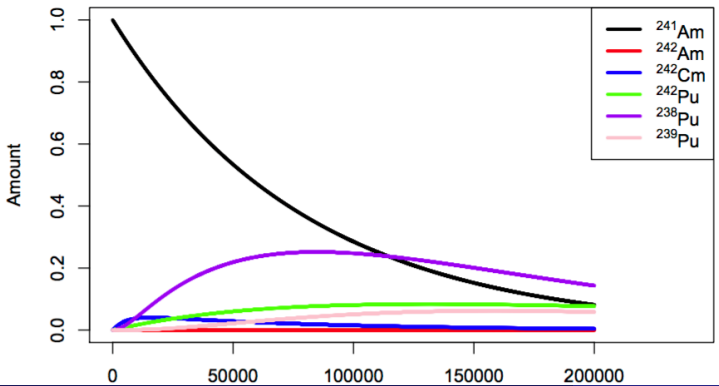


MYRRHA

Investigation using thorium fuel

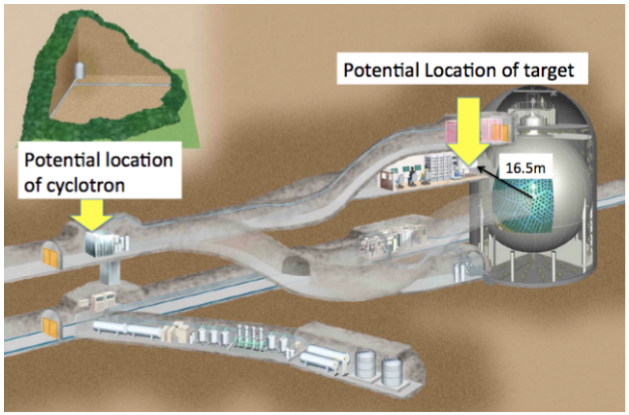
Just published. Studies of MYRRHA core with thorium fuel, as case study



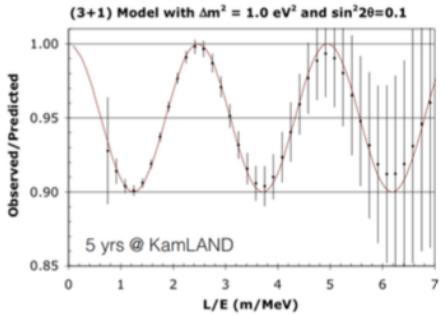


Show use as Minor Actinide burner. Studies done wth MCNPX - Geant4 validation to follow

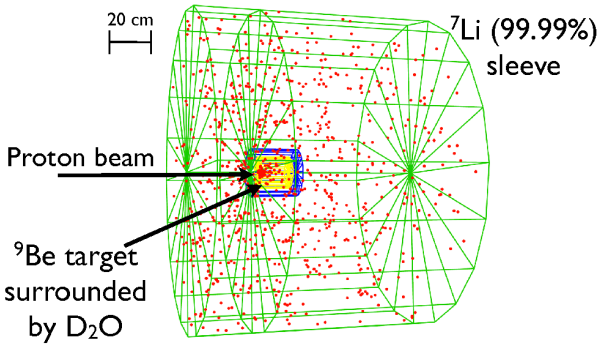
DAEδALUS and IsoDAR



Accelerator and target down the KAMLAND mine



Will really sort the sterile neutrino question



Careful design of target to produce antineutrinos

ADSRs and Thorium Power

Advertisement(2)

Continue to play ajor role in ADSR/thorium studies and advocacy

4th International Workshop on ADSRs and thorium fuel

Aug 31-Sep 2 in Huddersfield

Site and bookings about to go live.

Other stuff

Ask for details afterwards

- Production of PET isotopes in proton therapy (Tanjilul Amin)
- Neutron scanning - and its effects (Simon Albright)
- Understanding and parametrisation of spallation neutron spectra (Asiya Rummana)
- Shielding studies from Clatterbridge and Manchester (Roxana Rata)
- Proton Radiography with UPenn (Cezarina Chirvase)
- Proton energy measurements (with UCL)
- Optimising the space-charge dominated PSI injector II
- PASI target studies (Rob Edgecock, Criatian and Adriana Bungau)
- Radiotoxicity - the myth of RBE (Piyanud Thongjerm)
- The RFQ for FETS (Wanisa Promdee)
- Metamaterials (Aimee Hopper)
- Thorium ADSR studies (David Lee)
- Accelerator reliability using Markiv chains (Miha Rescic)
- 3D printing in metal (Innovate UK grant)

Finally

No undergraduate teaching - pure research institute with a radically new MSc course

University has tradition of strong links with industry continuing with industrial collaboration and the Buckley Innovation Centre

Not competing in areas where established groups are already strong but that still leaves plenty of scope