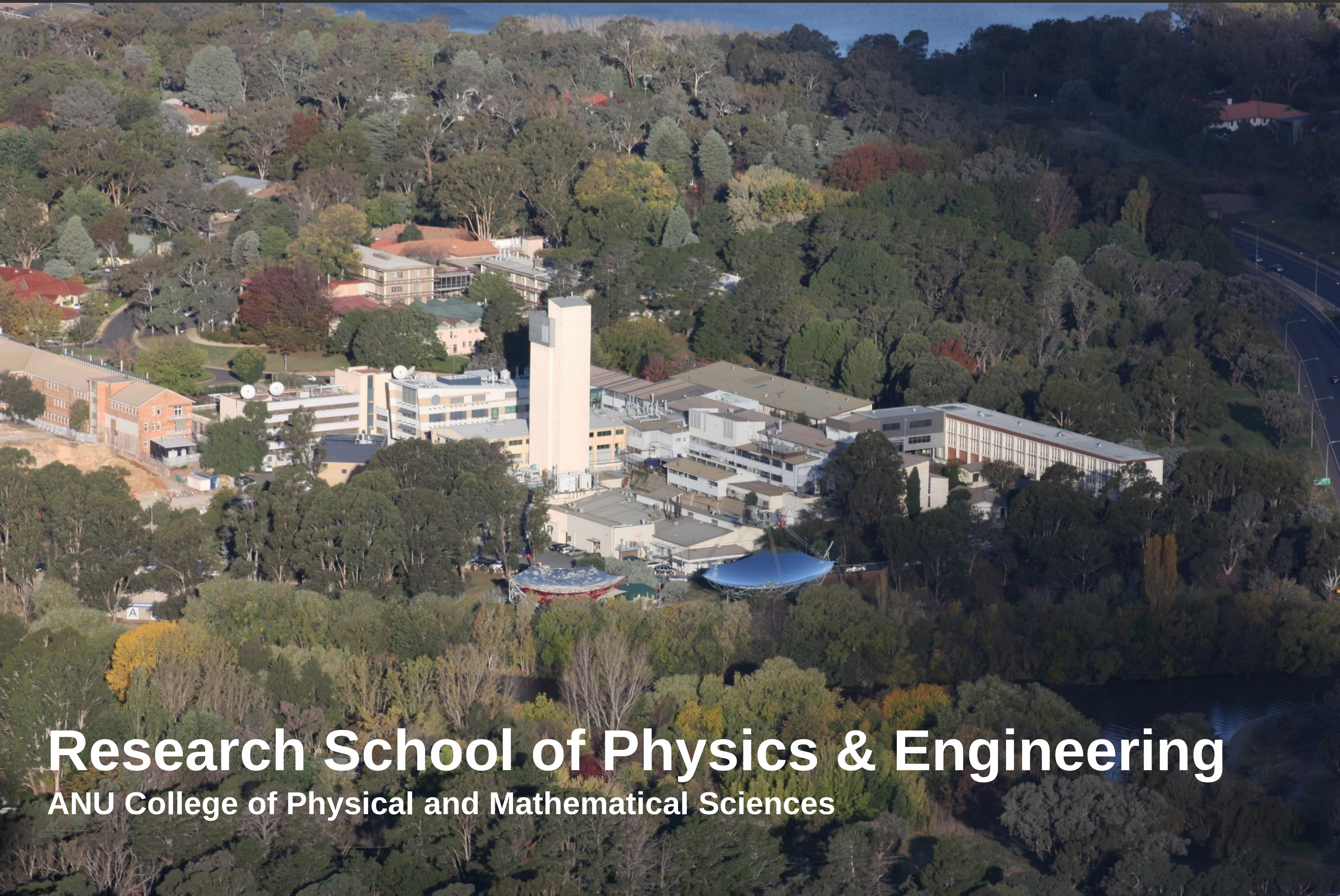
Australian National University



Research School of Physics & Engineering

ANU College of Physical and Mathematical Sciences

School overview

- Largest university physics research activity
- 9 Research Departments + Physics Education Centre
- 145 full time academic staff
- 80 technical staff (computational to mechanical)
- Most internationally collaborative in Australia
- > 300 visitors from 40+ counties each year
- > 200 HDR students from 30+ countries (1/3 female)
- 3 resident companies, 3 spin-offs, >20 active partners

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Fundamental Research

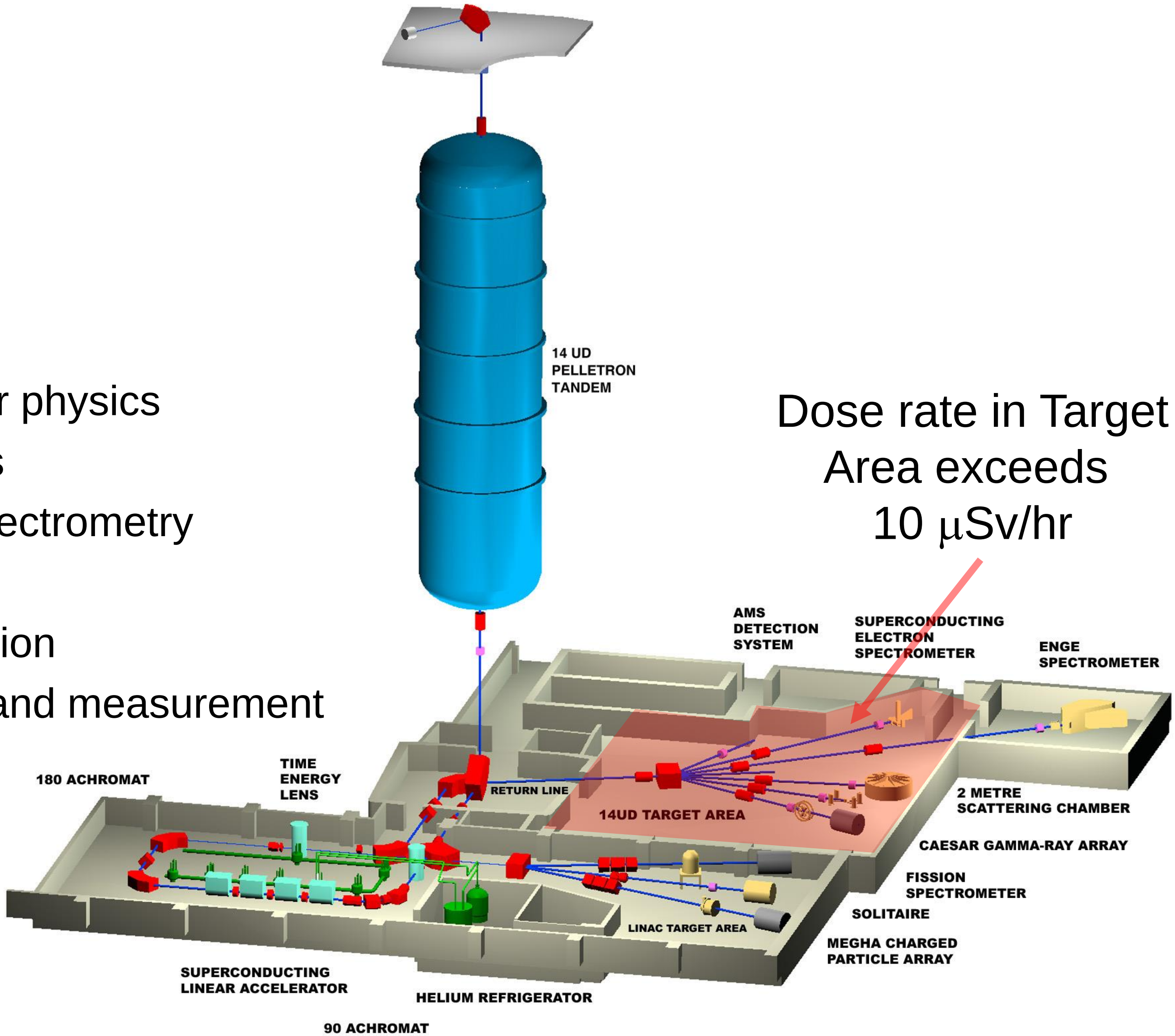
- Nanoscience
- Quantum & atom optics
- Non-linear physics
- Mathematical physics
- Atomic & molecular physics
- Antimatter-matter studies
- Nuclear science
- Materials & surface science
- Space science
- Plasmas/fluids
- Gravitational waves

National Facilities

- 14 UD accelerator – largest in southern hemisphere
- The Australian Plasma Fusion Research Facility
- Australian National Fabrication Facility ACT node
- National Antimatter (positron) Facility
- CTLab – national X-ray CT Facility

Heavy Ion Accelerator Facility

- Fundamental nuclear physics
- Nuclear astrophysics
- Accelerator mass spectrometry
- Particle accelerators
- Environmental radiation
- Radiation detection and measurement



Dose rate in Target Area exceeds 10 μSv/hr

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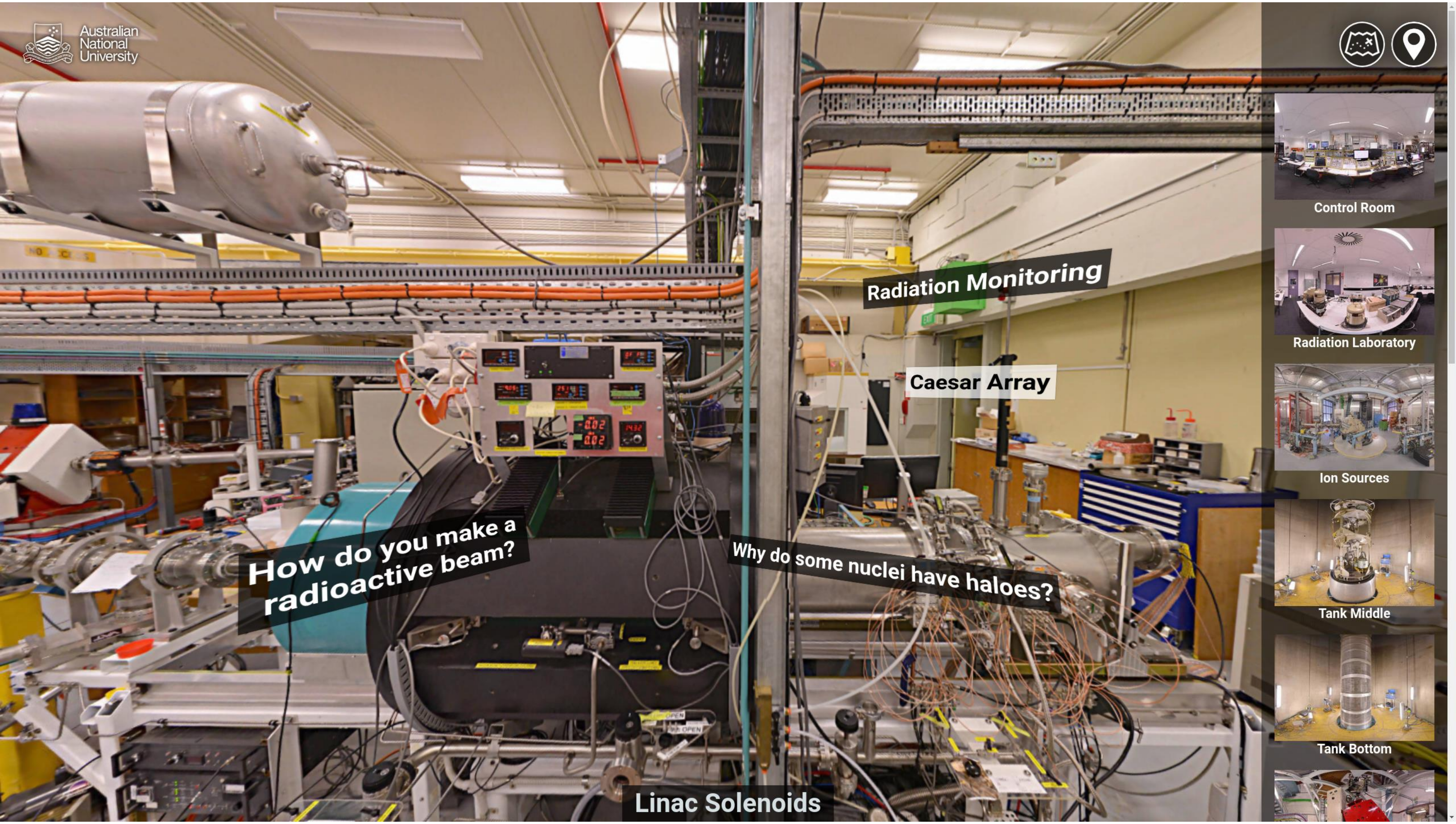


VR tour of facilities – for inductions and training

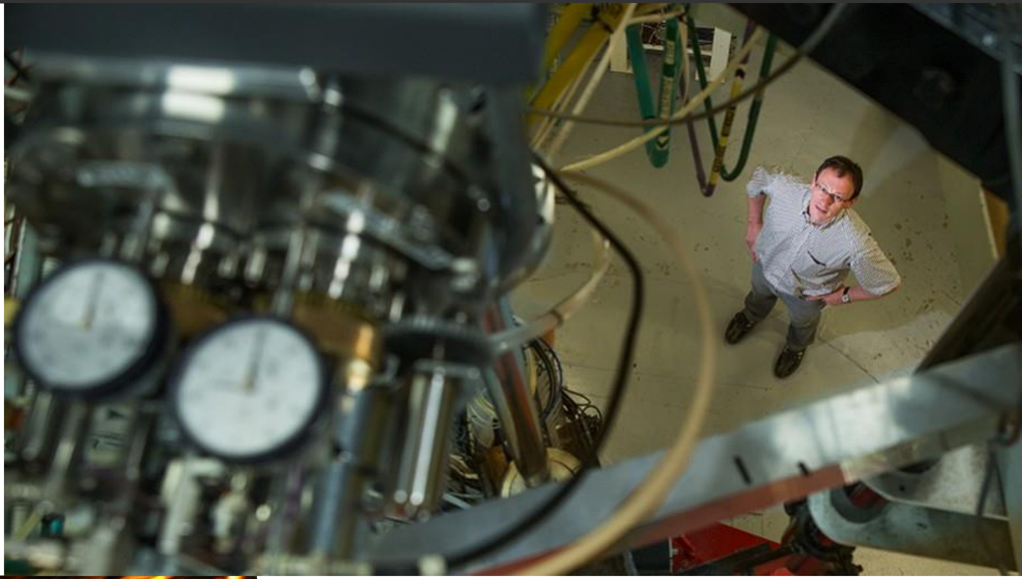
Radiation Monitoring

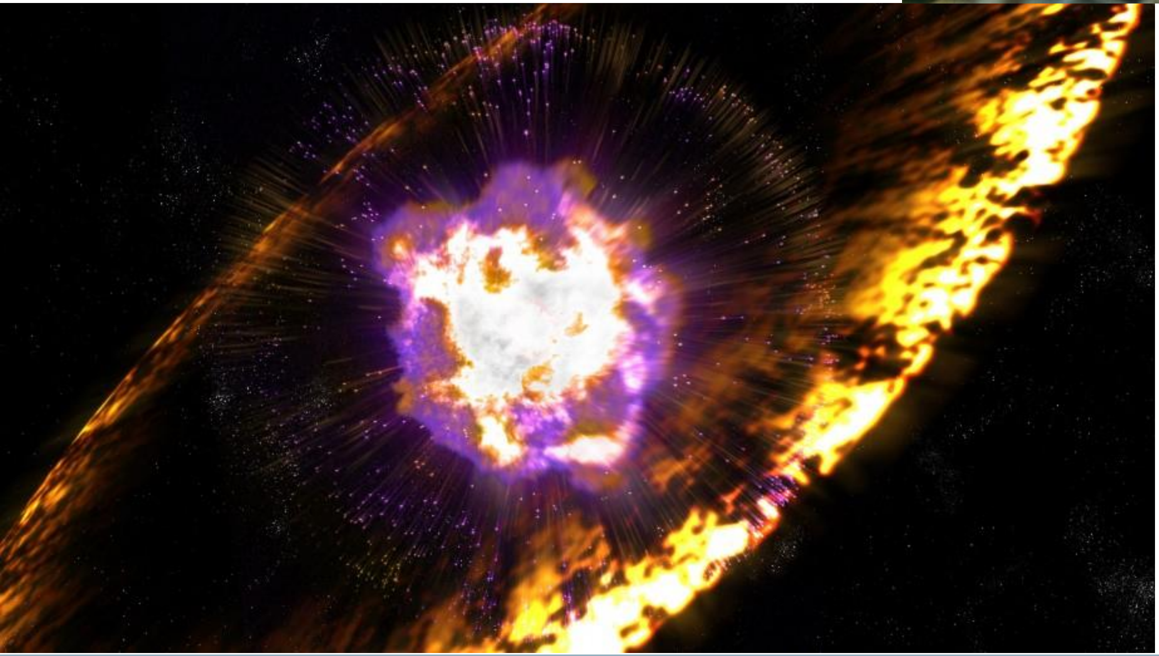
Neutrons, produced by the accelerated beam striking targets, beam defining apertures and beam dumps, are potentially the most significant contributor to radiological doses in the 14UD laboratories. Neutron detectors, placed at optimised locations around the experimental halls, continuously monitor neutron levels. Radiation levels above 10 micro-Sieverts per hour requires all entry doors to the area be continuously secured and warning lights to flash. Opening a door to an area where the dose rate exceeds 10 micro-Sieverts per hour automatically triggers a beam stop to be inserted upstream of the accelerator, removing the ion beam and hence the radiation source.

Highest elemental sensitivity for ^{60}Fe detection

Stellar fall-out from supernova creates a time-stamp for sediment
3.2 to 1.7 Mya and 8 Mya

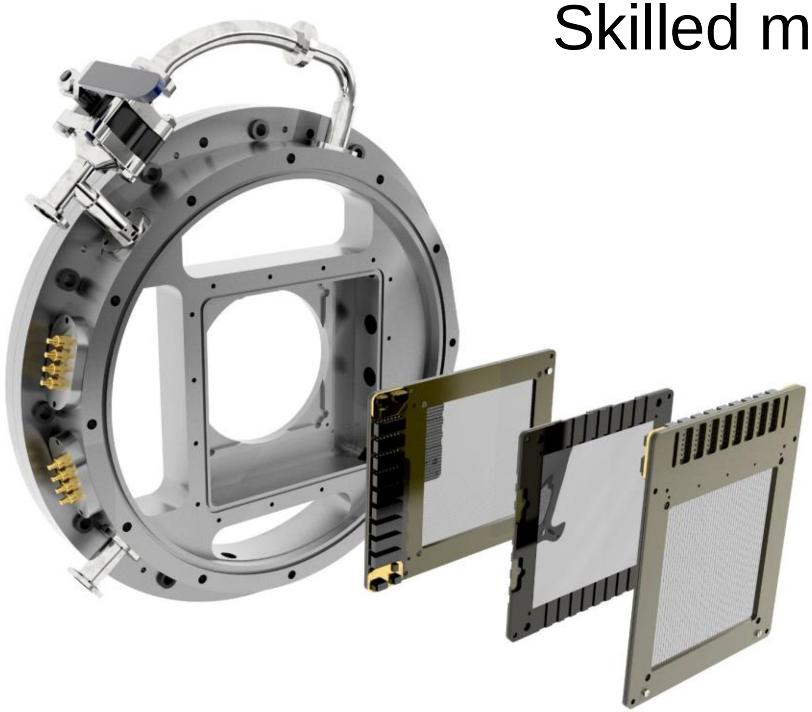
Detection at the zeptomolar level (10^{-21} mol.L^{-1})

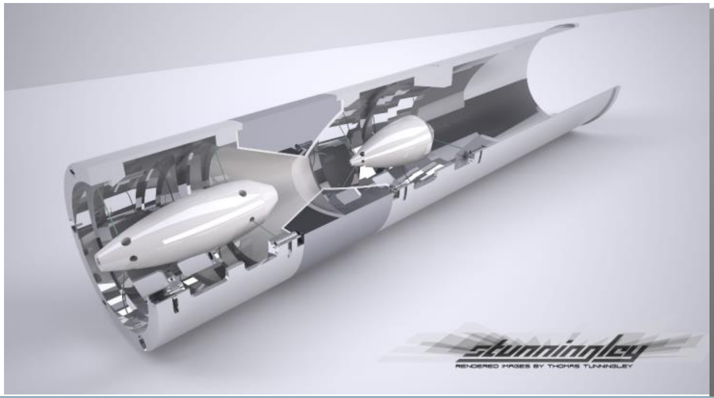


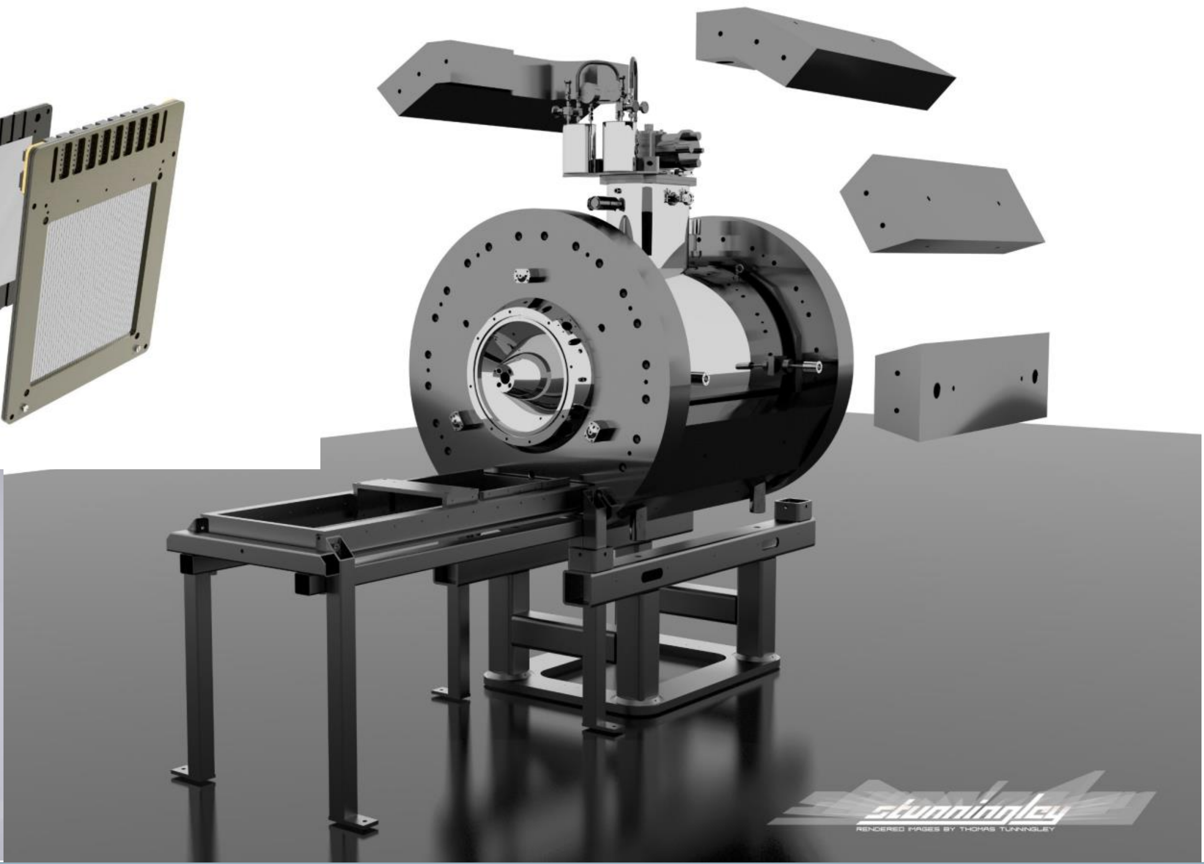


In collaboration with:
Uni of Vienna, Austria
Hebrew University, Israel
Shimizu Corporation & Uni of Tokyo
Nihon University
University of Tsukuba
Senckenberg Collections of Natural History Dresden
Helmholtz-Zentrum Dresden-Rossendorf (HZDR) in Germany

Skilled mechanical design and fabrication







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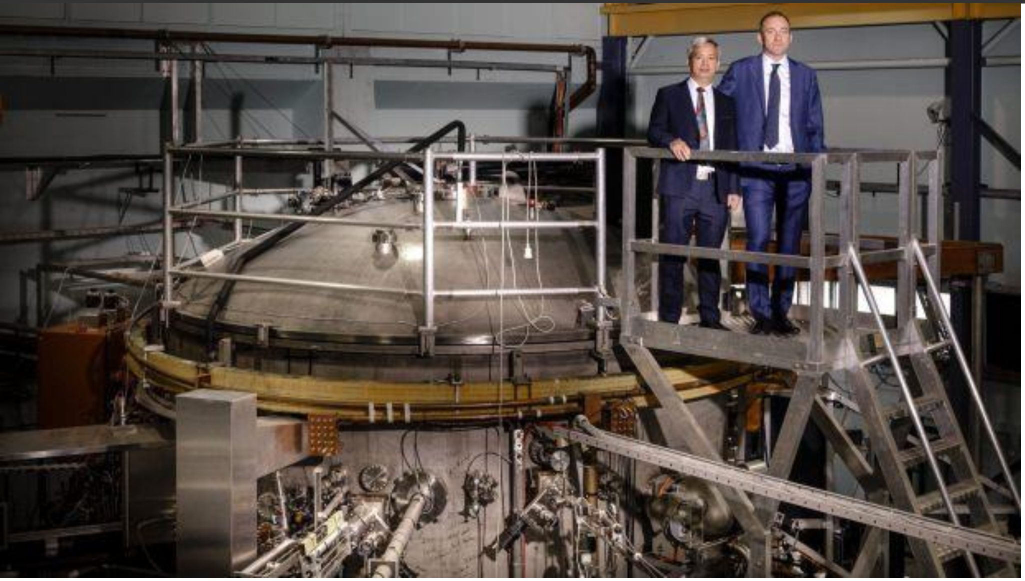
Fusion research

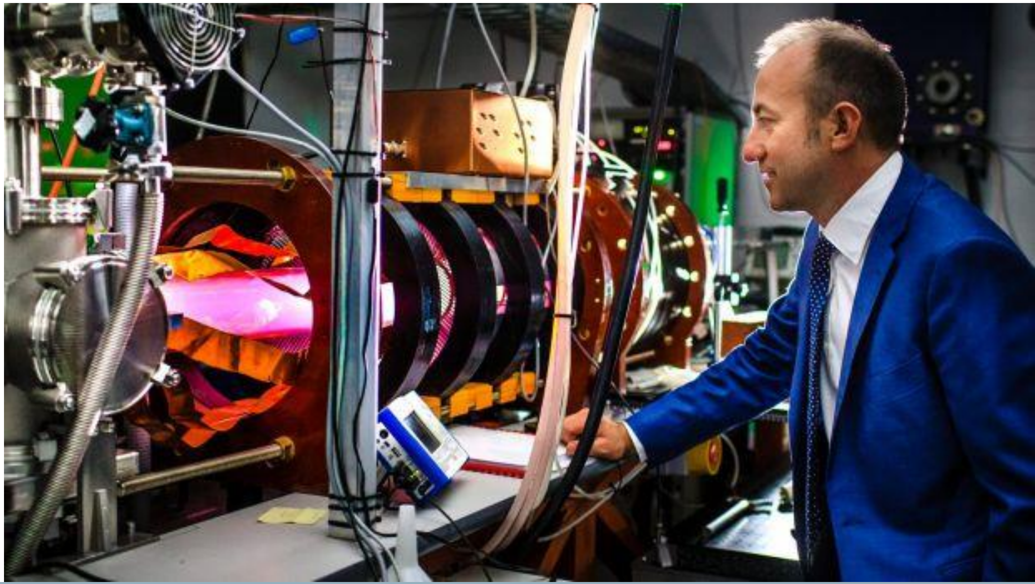


Magnetically confines plasmas at 150 million degrees

ANU’s Stellarator, *H1*, will move to University of South China this year

(400kW rf, 4 to 20MHz)

Will focus our research on plasma diagnostics with ANSTO for ITER, and developing test facilities for materials used in fusion reactors



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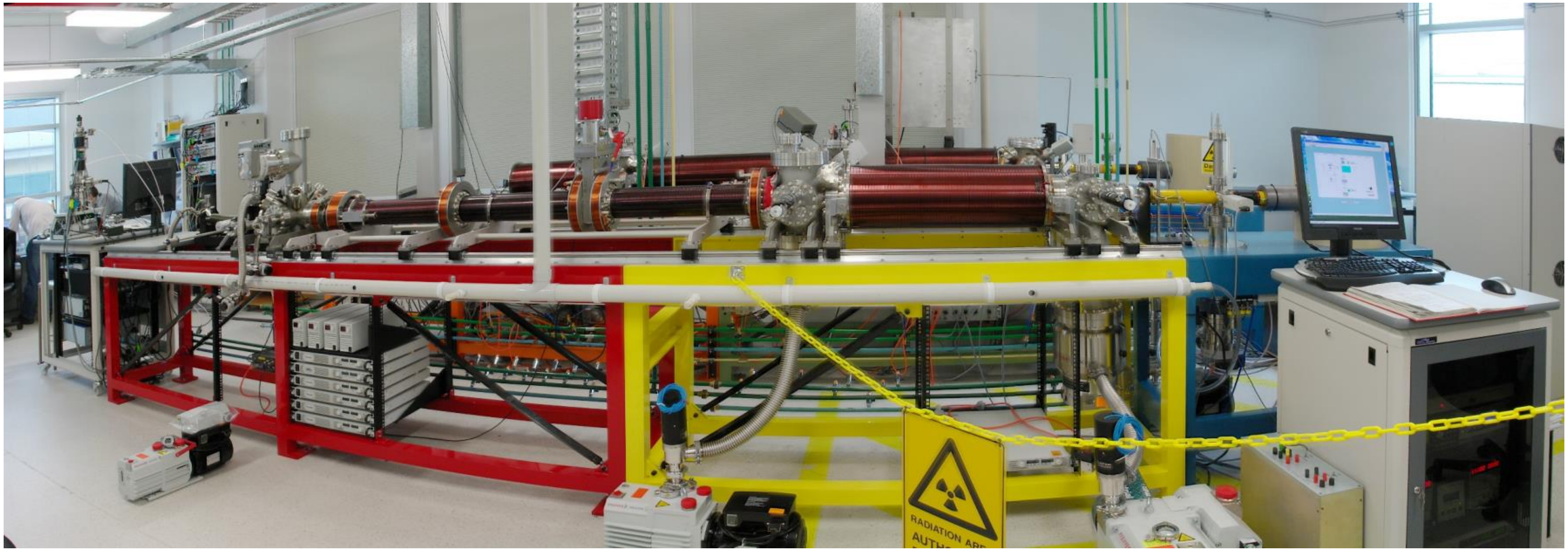
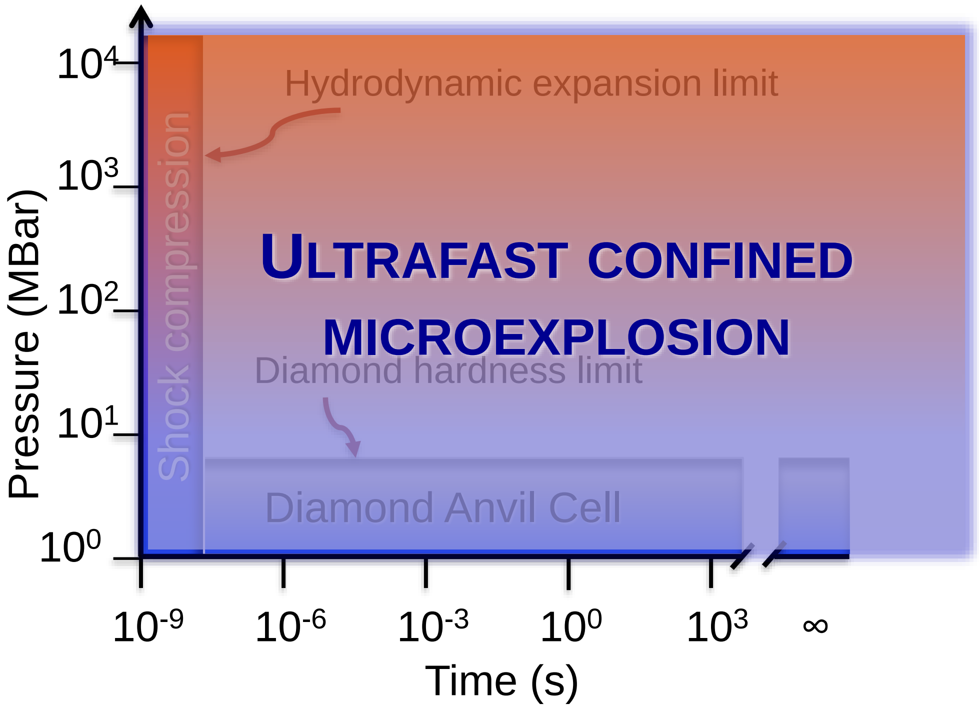
National Antimatter Facility

- Two beams lines for fundamental materials analysis
- Na-22 sources (initial activity 2 GBq)
- Positrons from beta decay (+ 1.27 MeV gamma)
- Tungsten and lead shielding



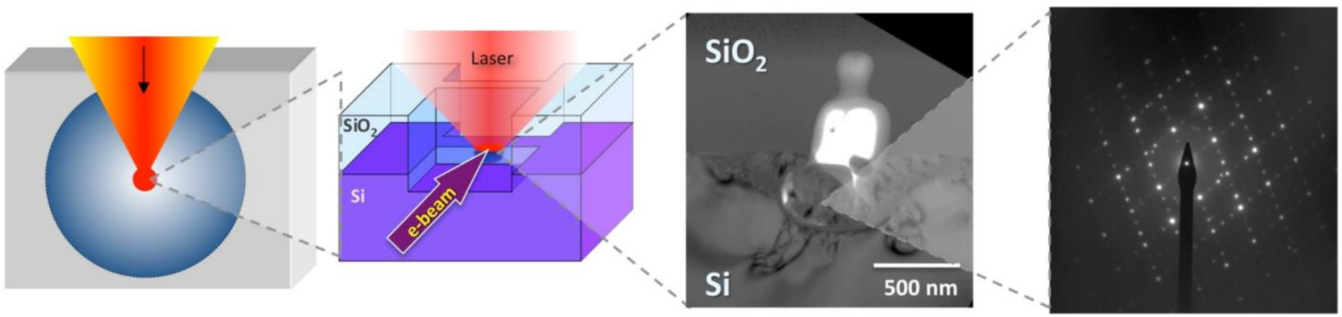
Ultrafast laser-induced confined microexplosion: a new tool to create high-pressure materials

Pressure – lifetime diagram



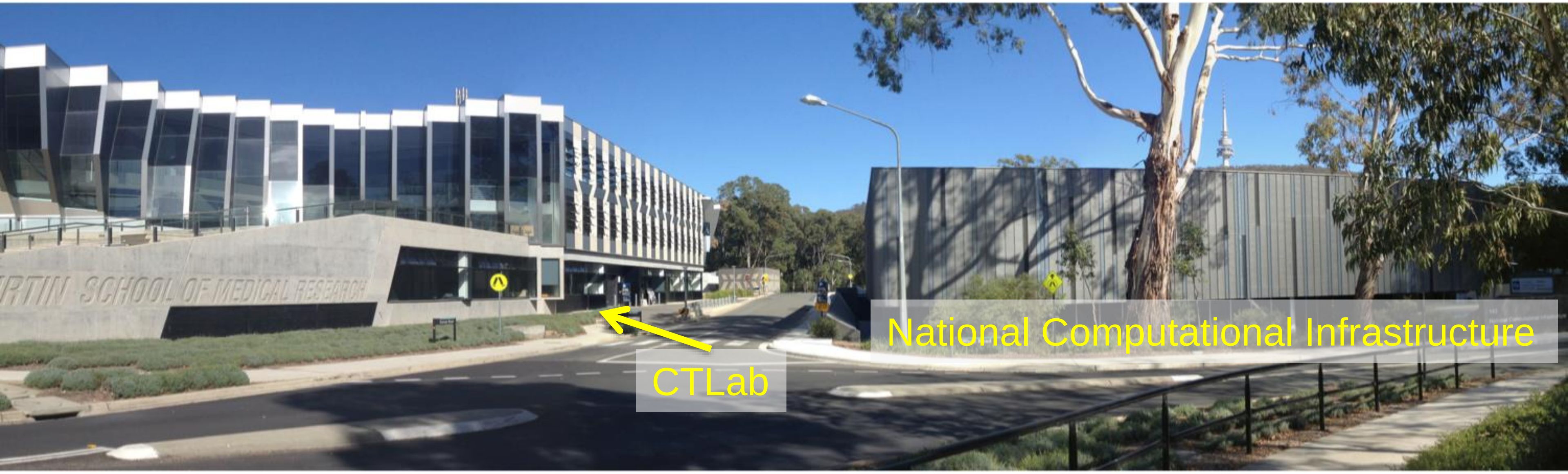
New discoveries:

- Spatial separation of elements in Warm Dense Matter (WDM) state
- New super-dense bcc-Al phase in Al_2O_3
- New tetragonal silicon phases bt8-Si & st12-Si
- Valence change of Fe-ions in olivine
- Ge – O spatial separation demonstrated by O_2 formation in voids in GeO_2
- Bright photo-luminescence from SiO_2 and N-vacancy in c-BN



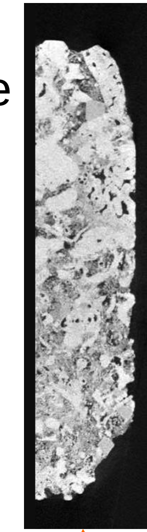
CTLab – a micro-CT facility

- visualisation room & 2 **colour 3D printers**
- Five 180kV CT (1 **nano**-, 3 **micro,** 1 **meso**-CT)
- **300kV CT universal scanner** (late-2017)
- **SEM-based** mineral mapping, petrophysical mapping
- Sample prep equipment
- Dedicated fibre to NCI



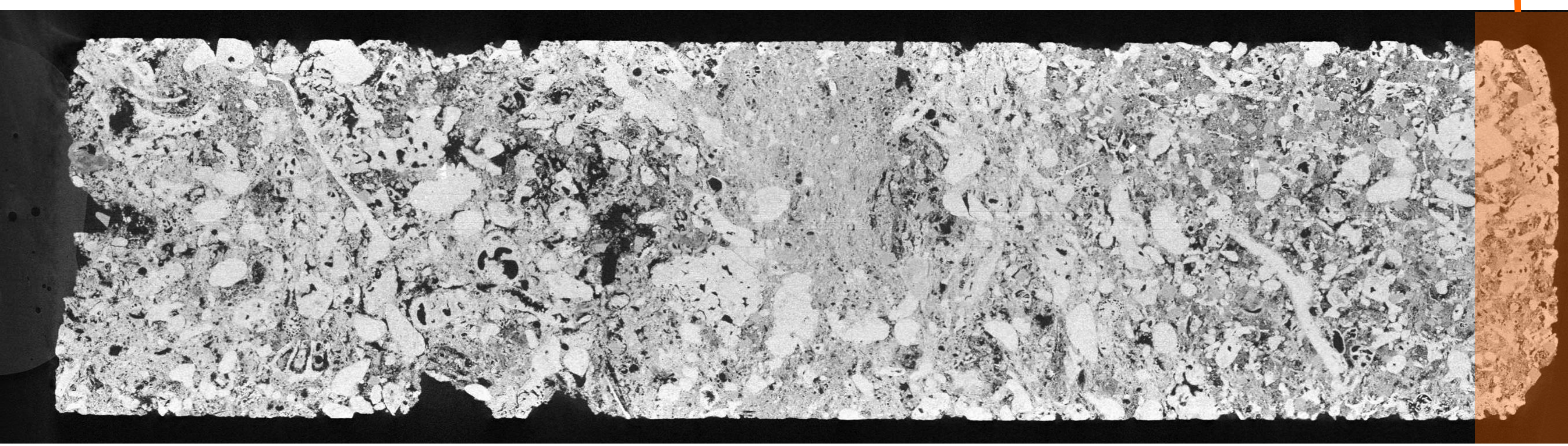
- Higher geometric and signal fidelity
- > 3 to 10 times faster than conventional CT
- Larger length scales at highest resolution

Under the same conditions a conventional micro-CT might only scan this much.



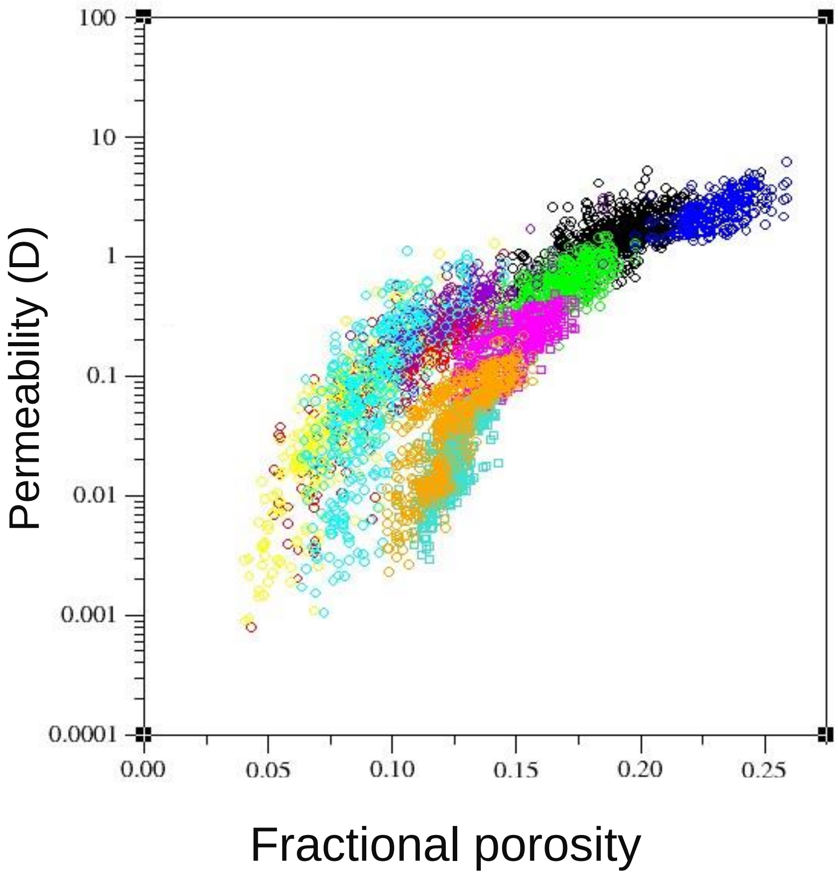
Hardware team: Andrew Kingston, Trond Varslot, Adrian Sheppard, Shane Latham, Glenn Myers, Paul Veldcamp, Tim Sawkins, Ron Cruikshank

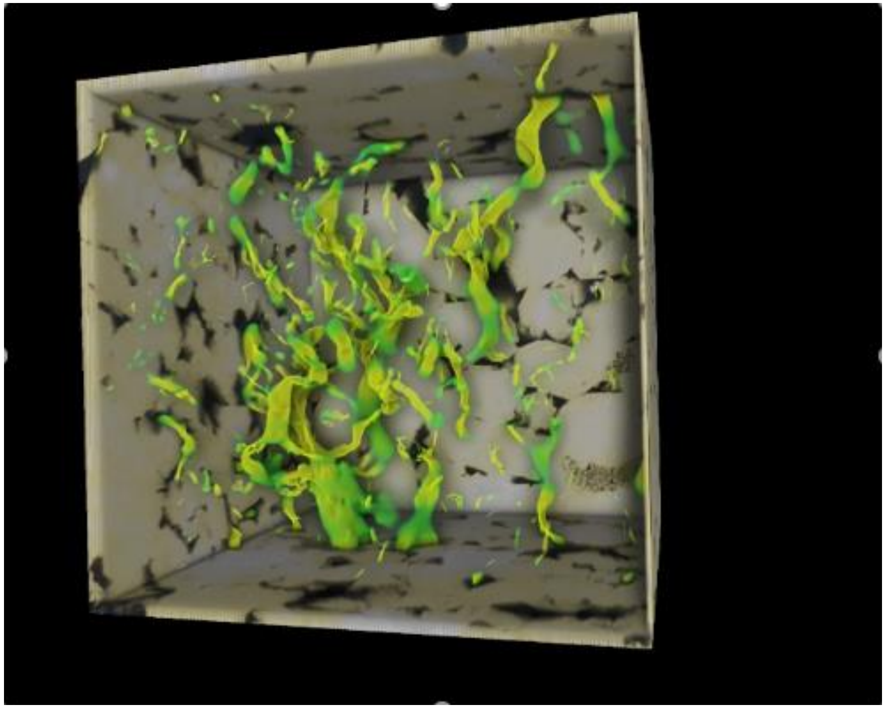
Heliscan™



40 Gbyte scan of carbonate core (5mm diameter, 20mm long, 3.5 micron resolution)

Tomography provides the framework





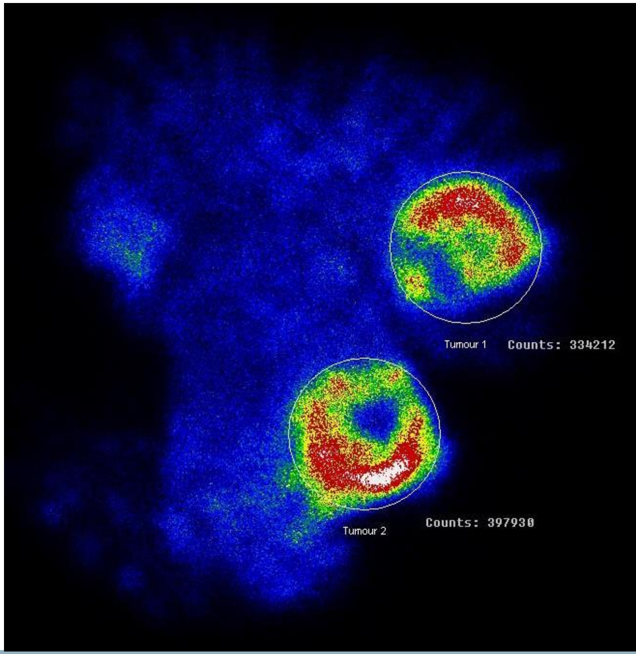
~ 1 mm^3 sandstone showing flow simulation

Developments in Radiotherapy

Professor Ross Stephens
Sirtex Chair

GE Hawkeye SPECT-CT

Excised rabbit liver
showing labelled tumours



in vivo animal studies:
Tc-99m, Ga-67, Lu-177, In-111,Y-90
A partnership with Sirtex Medical