SUPA Physics Scotland

SUPA Foresighting Meeting – 9th May 2016

Nuclear and Plasma Physics

- Theme Leader Professor Dino Jaroszynski (since 2011)
- Dino Jaroszynski
- Dave Wyper
- David Hamilton
- Bernhard Hidding
- Paul McKenna
- **Theme:** Glasgow University, Strathclyde, Edinburgh and UWS – opportunities to include Dundee and Aberdeen for imaging applications

Existing Scope of Theme

- Plasma Physics
- Laser-plasma based accelerators and radiation sources
- Nuclear physics: nuclear structure and photo-nuclear physics
- SCAPA as an enabling facility for cross-disciplinary science
- New opportunities at ELI for photo-nuclear phsics, High field physics and applications

Scottish Centre for the Application of Plasma-based Accelerators (SCAPA)

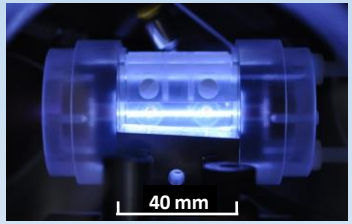
SCAPA

• Expansion of **ALPHA-X** laser-plasma accelerator facilities at Strathclyde with new laboratories.

• In-depth programme of **Applications**.
• Accelerator and source **Research & Development**.
• Knowledge Exchange & **Commercialisation**
• Engagement in European and other large projects.
• **Training:** Centre for Doctoral Training in the Application of Next Generation Accelerations

• **3 shielded areas** with **7 accelerator beam lines**.

• High-intensity femtosecond laser systems:
  a) 350 TW (with provision for PW) @ 5 Hz,
  b) 40 TW @ 10 Hz,
  c) sub-TW @ 1 kHz.
• High-energy **proton, ion and electron** bunches.
• High-brightness fs duration **X-ray & gamma-ray** pulses.



Compact GeV electron accelerator and gamma-ray source

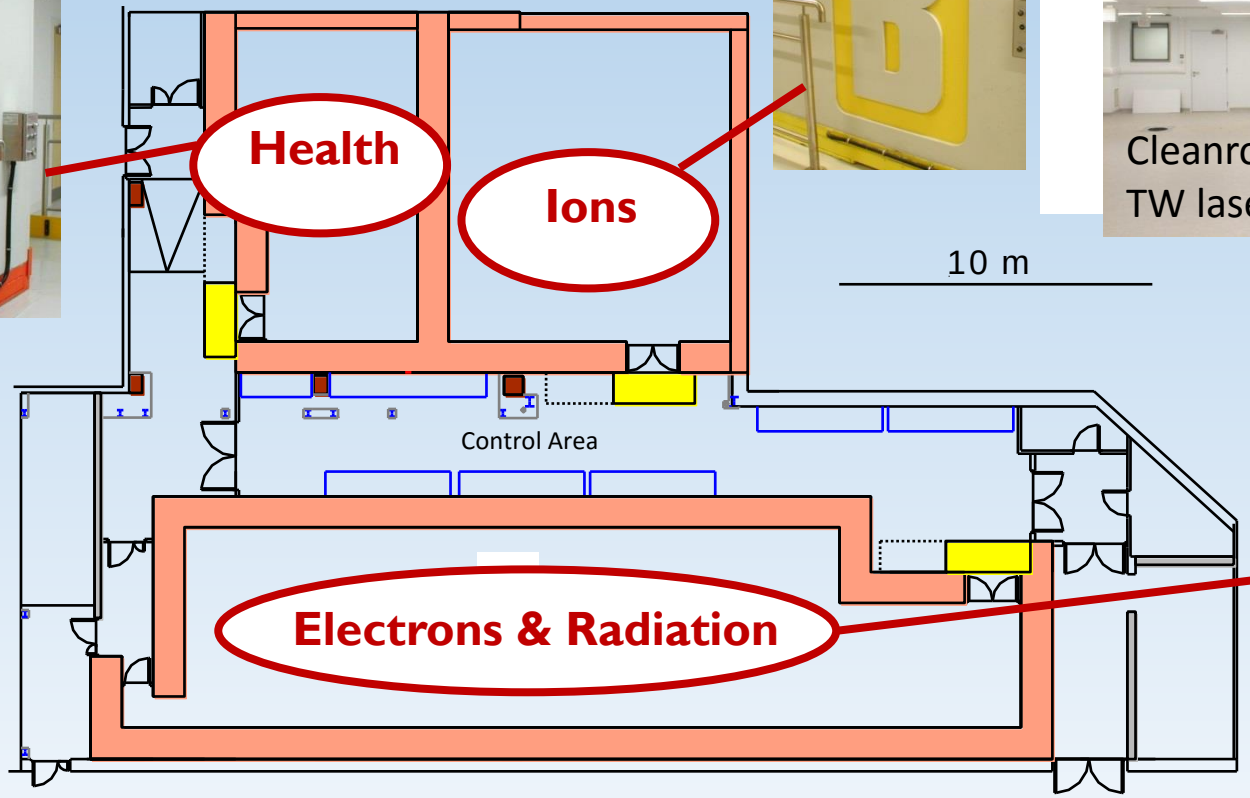
APPLICATIONS

• Radiobiology
• Ultrafast Probing
• High-Resolution Imaging
• Radioisotope Production
• Detector Development
• Radiation Damage Testing

SCAPA: new 1200 m² lab

Concrete doors on air skates

SCAPA Bunkers



new 1200 m² lab

Potential Areas for Development

- SCAPA: beamlines for nuclear, plasma and applications of coherent X-ray radiation
- CDT in next generation accelerators (EPSRC funded) & two in-house University supported CDTs: could be expanded
- CLF at RAL
- ELI: photo-nuclear and high field phsyics
- Nuclear physics facilities
- New coherent XUV radiation source applications: cross Theme and cross Pooling
- Imaging collaboration through SINAPSE

Concluding Remarks

- **Basic laser-plasma and nuclear research:** plasma instabilities (analogues of astrophysical gamma ray bursts, jets, cosmic rays), collective processes (laser-beam-radiation interactions)
- **Laser-wakefield accelerators:** ultra-compact next-generation accelerator: attosecond bunch acceleration, high energies
- **Compact radiation sources:** ultra-compact replacement for the free-electron laser (ion channel laser (ICL)), THz sources, attosecond to zeptosecond coherent X-ray sources, gamma rays
- **High field physics:** radiation reaction (QED, non-perturbative, non-linear), highly radiating systems
- **Applications:** radiotherapy, medical imaging, medical radio-isotope production, Raman and Compton amplification
- **Laser-driven high energy density physics** (e.g., laboratory astrophysics, physics for advanced fusion concept)
- **New ion acceleration schemes** based on laser radiation pressure and relativistically induced transparency
- **Radiation damage**: Space radiation reproduction and testing of electronics & space radiobiology
- **Ultra-fast science:** attosecond coherent X-ray radiation sources