

## SUPA: TEOPS Initiative

Potentially the most exciting discoveries in physical science are expected in the fields of astronomy, astroparticle physics, and particle physics over the next ten years. Gravitational waves from violent astrophysical systems in the Universe are on the point of discovery, particle physics promises to give us new insights into the fundamentals of matter and what happened in the early Universe, and astronomy could well produce evidence of life in other planetary systems in the Universe. Scottish research groups are playing world-leading roles in these areas and are extending their influence by closer collaboration.

The TEOPS (**T**echnology for **E**xperimental and **O**bservational **P**hysics in **S**cotland) initiative brings together the Institute for Gravitational Research (IGR), the Experimental Particle Physics (PPE) group (both at the University of Glasgow) and the UK Astronomy Technology Centre (ATC) in Edinburgh. This proposal spans the areas of particle physics, astrophysics and astronomy with a common theme of leading edge technology.

## Institute for Gravitational Research

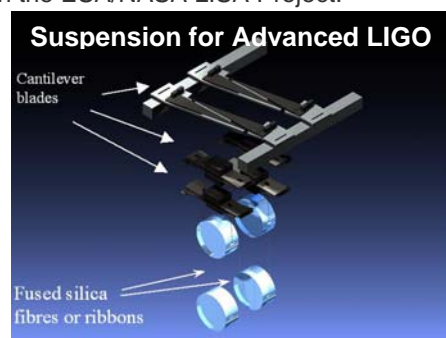
Scotland is unique in having in Glasgow the principal UK experimental team at the forefront of research towards the detection of gravitational radiation.



The Institute for Gravitational Research (IGR), under its Director Professor J. Hough FRS, plays a leading part in the UK/German GEO 600 experiment, in the US LIGO project and in the ESA/NASA LISA Project.

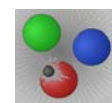
*Examples of current/recent projects include:*

- Development of novel interferometric techniques
- Development of systems of ultra-low mechanical loss for the suspension of mirror test masses
- Development of multiple pendulum systems using silica fibres to support the test masses
- New bonding technology (hydroxide-catalysis bonding), which exhibits very low mechanical loss and is compatible with ultra-high vacuum



## Experimental Particle Physics: Detector Development

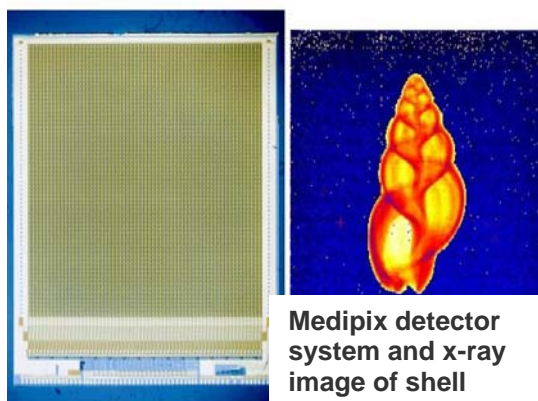
The University of Glasgow has a strong experimental particle physics group (PPE), under the leadership of Prof. D. Saxon FRSE, renowned worldwide not only for its fundamental research in experiments such as Aleph and ATLAS at CERN but also for its applied research in the area of innovative imaging particle and x-ray detectors.



The Detector Development group is involved in a wide range of projects related to imaging, radiation detection and detector development, within particle physics, medicine, biology and generic technology development.

*Examples of current/recent projects include:*

- CERN ATLAS** - Production and testing of modules for the LHC/ATLAS
- CERN LHCb** - Design of LHCb/Velo upgrade detectors
- CERN Medipix** - High sensitivity X-ray imaging for medical and synchrotron applications
- CERN RD50** - New technologies for super radiation hard detectors
- Retinal imaging** - Measuring the electrical activity of retinal tissues
- Retinal implants** - Pixel detectors as a cure for some forms of blindness



**Medipix detector system and x-ray image of shell (collaborative work with CERN Medipix)**

**3D** - Novel detector geometry for high speed radiation hard detectors

**Silicon carbide** - Materials for high radiation environment

**Gallium nitride** - Materials for protein studies

**Gallium arsenide** - Materials for enhanced X-ray detection

**Detector simulation** - Simulation using tools such as Medici, ISE, MCNP, Geant4 and SRIM coupled with the ScotGrid computing hardware

**Active pixel sensors** - New pixel detector technologies

## UK Astronomy Technology Centre

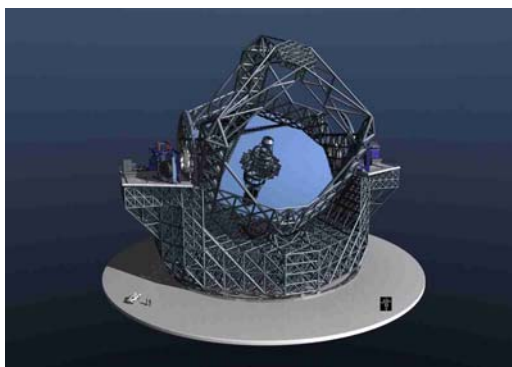
The UK Astronomy Technology Centre (UK ATC) at the Royal Observatory Edinburgh is PPARC's flagship facility for the design and construction of unique astronomical instrumentation. The mission of the UK ATC is to **keep the UK at the forefront of World astronomy** by continuing to produce the scientific hardware required to enable cutting edge astronomy to be undertaken.



Science & Technology Facilities Council  
UK Astronomy Technology Centre

Some current / recent projects include:

- **WFCAM** – the largest infrared camera ever built, a cryogenic instrument now undertaking unique surveys in the Northern Hemisphere skies
- **SCUBA2** – the successor to SCUBA, one of the most successful ground-based instruments ever built, utilising a new generation of sub-millimetre CCD-like detectors
- **MIRI** – hosting the European PI and opto-mechanical design leads for this key instrument on the JWST, successor to the Hubble Space Telescope
- **VISTA** – an infrared survey telescope destined for the Southern hemisphere and a component of the UK's membership of [ESO](#), the European Southern Observatory
- **KMOS** – the K-band (2.2  $\mu\text{m}$  wavelength) Multi-Object Spectrometer, will be a second-generation instrument for one of the ESO Very Large Telescopes; the UK ATC is part of the consortium designing and building this instrument
- **European Extremely large telescope (E-ELT)** – The UK ATC is leading the UK's work towards an optical and infrared telescope of up to 42 m in diameter, recently approved into the design phase by ESO Council



### The European Extremely Large Telescope concept (Courtesy European Southern Observatory)

In addition to SUPA, the UK ATC is involved in several UK and European network and technology development initiatives coordinated by our Technology Development Director, Colin Cunningham;

- **Photonics KTN** The UK ATC is a managing partner in this DTI-funded network
- **OPTICON** A European network in Optical and Infrared astronomy
- **Smart Focal Planes** A technology development programme aimed at maximising focal plane 'real estate' in the next generation of Extremely Large Telescopes
- **ERP-IIS** Collaborative R&D with Heriot Watt and Edinburgh Universities

## Further Information

Adam Woodcraft  
Royal Observatory Edinburgh  
Edinburgh  
EH9 3HJ  
Phone: 0870 765 1873  
Email: [alw@roe.ac.uk](mailto:alw@roe.ac.uk)

Christian Killow  
Dept. of Physics and Astronomy  
Kelvin Building  
University of Glasgow G12 8QQ  
Phone: 0141 330 3376  
Email: [c.killow@physics.gla.ac.uk](mailto:c.killow@physics.gla.ac.uk)

Calum Torrie  
Dept. of Physics and Astronomy  
Kelvin Building  
University of Glasgow G12 8QQ  
Email: [c.torrie@physics.gla.ac.uk](mailto:c.torrie@physics.gla.ac.uk)