SUPA Physics Scotland

Condensed Matter and Materials Science

Theme Leader: Stephen McVitie (Glasgow)

CMMS Activities: Edinburgh, Glasgow, St Andrews, Strathclyde
Dundee, Aberdeen, Heriot-Watt, UWS

Facilities:

Ultra-low-vibration lab, in-situ spectroscopy, cleanrooms, and oxide MBE facility (*St Andrews*);

CSEC high-pressure labs (*Edinburgh*);

MAGTEM and Xenon plasma FIB (*Glasgow*);

2D materials, photonics and device fabrication facility (*Heriot-Watt*).

Existing Scope of Theme

Core topics:

- Correlated systems, novel phases of matter, advanced quantum materials *(St A., Edi.)*
- Microscopy for functional materials *(Glas., Strath.)*
- Soft condensed matter *(Edi.)*
- Nanomaterials and quantum information *(H-W, St A.)*
- Optoelectronic devices *(St A., Glas., Strath., H-W.)*
- Electron paramagnetic resonance *(St A., Dundee)*
- Advanced materials characterization; electron magnetic resonance *(St A., Dundee),* positron annihilation spectroscopy *(Dundee),* TEM/STEM *(Glas)*
- Thin films, sensors, and imaging *(UWS)*

Some Areas of overlap with other themes:

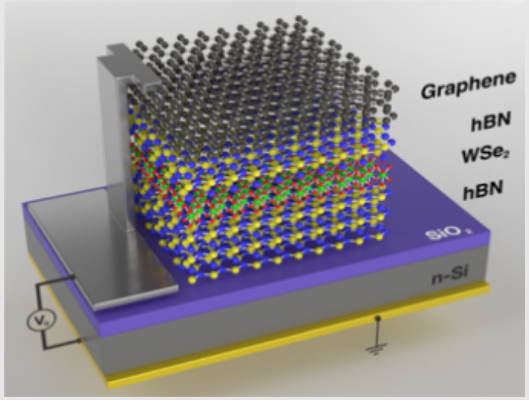
- Biological physics *(Edi., Abdn, Dundee)* – **PALS**
- Solid oxide fuel cells *(Abdn)* – **Energy**
- Organic LEDs and photovoltaics *(St A., Strath., H-W, Dundee)* – **Energy**
- Laser-engineered surface structures *(Dundee)* – **Particle Physics**
- Single-photon sources *(Heriot-Watt)* – **Photonics**

Publication Highlights

Coulomb blockade in 2D quantum dot

H-W + Sweden, India, USA, Japan

Nature Nanotechnology **14**, 442–446 (2019)



Chain-melted phase of matter

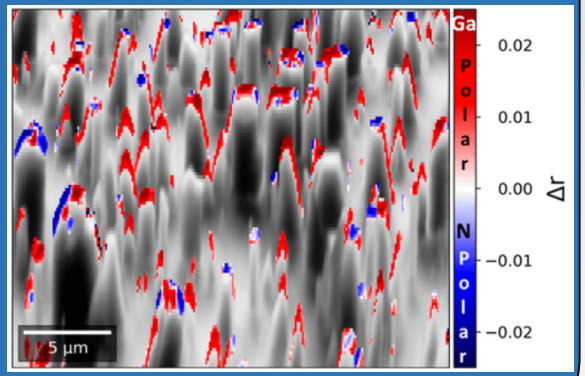
Edinburgh + China

PNAS **116 (21)** 10297-10302 (2019)

GaN Nanowire Polarity and Light Emission in the SEM

Strathclyde + Sheffield, Germany

Nano Letters (2019)

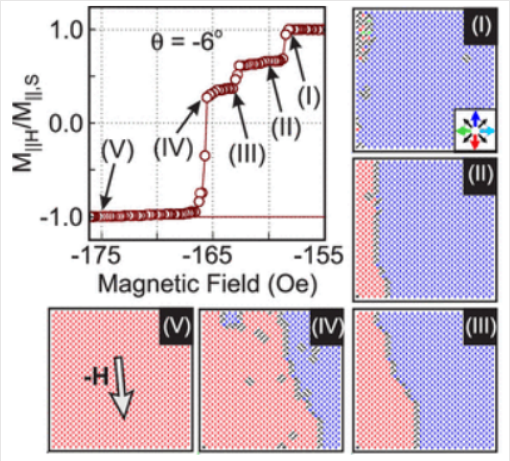


Publication Highlights

Superferromagnetism in 'Pinwheel' Spin Ice

Glasgow + Leeds, Canada, USA, Brazil

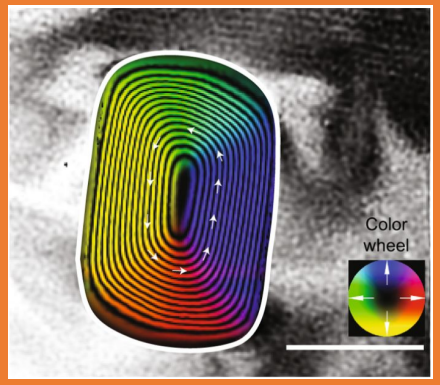
ACS Nano **13** 2213 (2019)



The oldest magnetic record in our solar system

Glasgow + Edinburgh, ICL, NHM, Norway, Germany

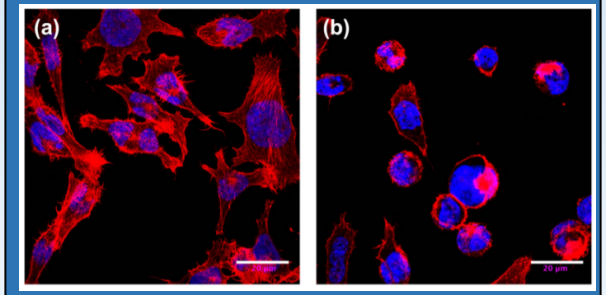
Nature Comms **9** 1173 (2018)



A minimal rupture cascade model for living cell plasticity

Aberdeen + France

New J. Phys. **20** 053057 (2018)

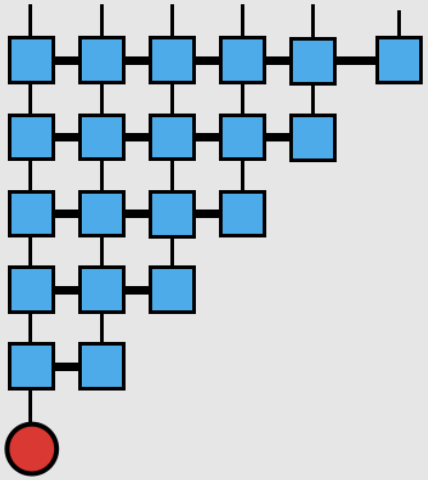


Publication Highlights

Ultra-efficient method for open quantum system simulation

St Andrews

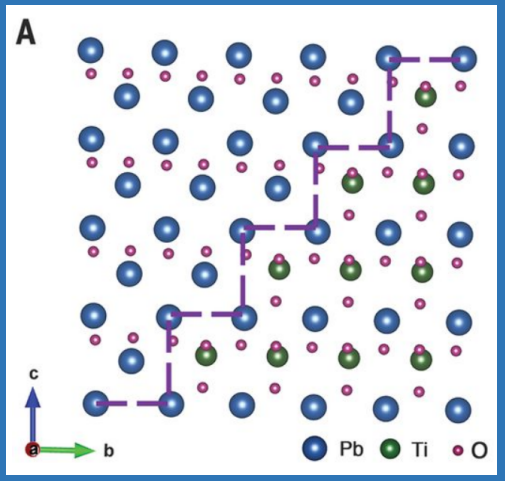
Nature Comms **9** 3322 (2018)



Highest value of polarization ever seen in a crystal

St Andrews + China, Israel, USA

Science **361** 494 (2018)



Recent Appointments

Heriot-Watt

Dr Margherita Mazzera

Solid-State Quantum Memories

From: ICFO, Barcelona
Appointment: Reader

Strathclyde

Dr Konstantinos Lagoudakis

Polariton condensates

From: Stanford
Appointment: Reader

Glasgow

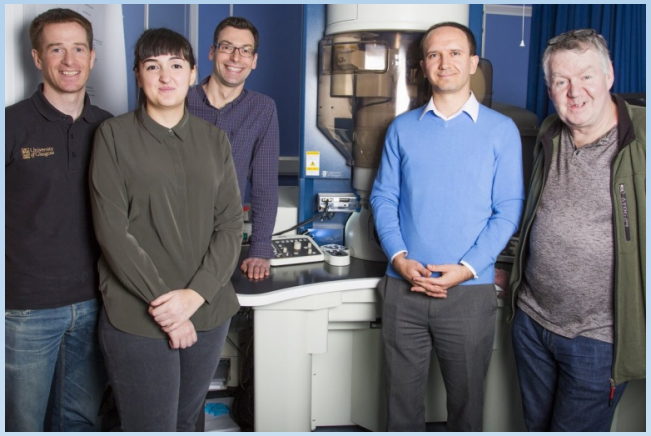
Dr Amalio Fernandez-Pacheco

3D Nanostructures

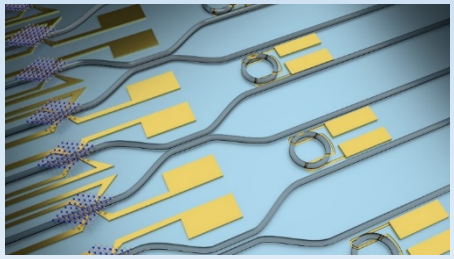
From: Cambridge
Appointment: Senior Lecturer

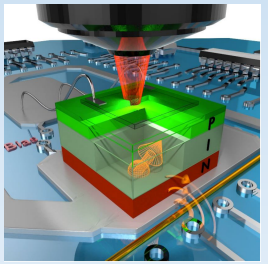
Commercial, Funding, Awards Success

- ***TEM detector commercialization***
  - Glasgow MCMP, PPE and IGR
  - High speed imaging detectors for TEM
  - 10 units, £1.0M+) 4 in last year



- ***Larger grants include***
- Scalable 2D Quantum Integrated Photonics (EC, €3.6M, Gerardot, H-W)
- MOSQUITO: MObile Spin-based QUantum Information sTOrage (EPSRC, £1.2M, Bonato, H-W)

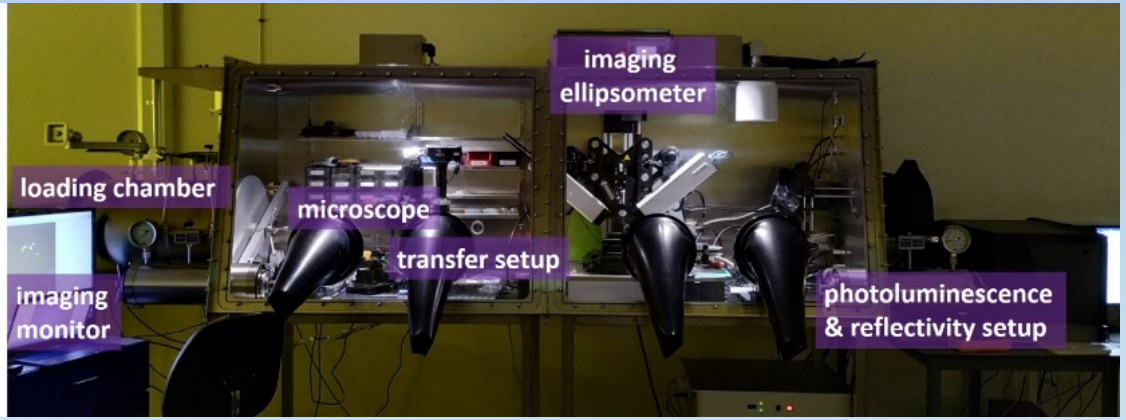




- ***Student Prize***
- Bruker Thesis Prize for outstanding work by PhD students in the field of ESR Spectroscopy.
- *Claire Motion* (St Andrews)

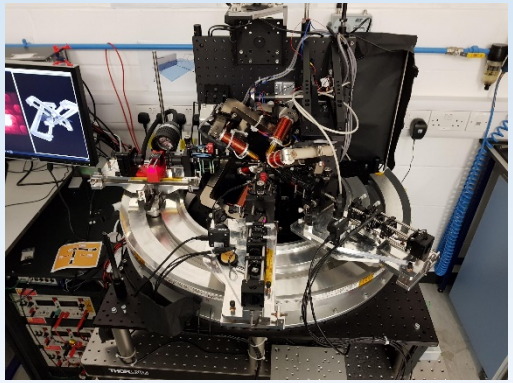
Equipment and Facilities

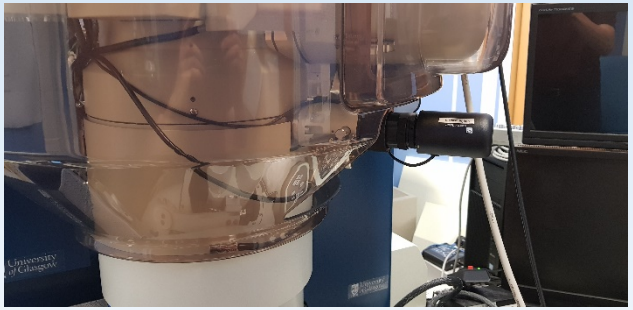
H-W
EPSRC User Facility:
2D Photonics Fabrication Facility
(Embedded in H-W cleanroom)



Glasgow
MOKE setup for dynamical magnetisation characterisation and imaging

Electron holography capability for sensitive phase imaging added to MAGTEM aberration corrected TEM/STEM.





Summary

- Condensed Matter and Materials Science is flourishing within SUPA
- Appointments show that have SUPA provides an attractive environment for recruitment of world-class staff
- PhD numbers are variable with some CDT continuation, outside of this perhaps not so clear (e.g. EC, EPSRC DTA)
- Investment in top-end experimental facilities to match talent pool is apparent and visibly continuing
- Theme is wide ranging and there is definite scope for further collaborations and bringing together of expertise notably materials and techniques/characterisation
- SUPA future aims should be consistent with those of major funders and look also to roadmaps in key areas
- Strong cross theme elements are present and further opportunities clearly exist