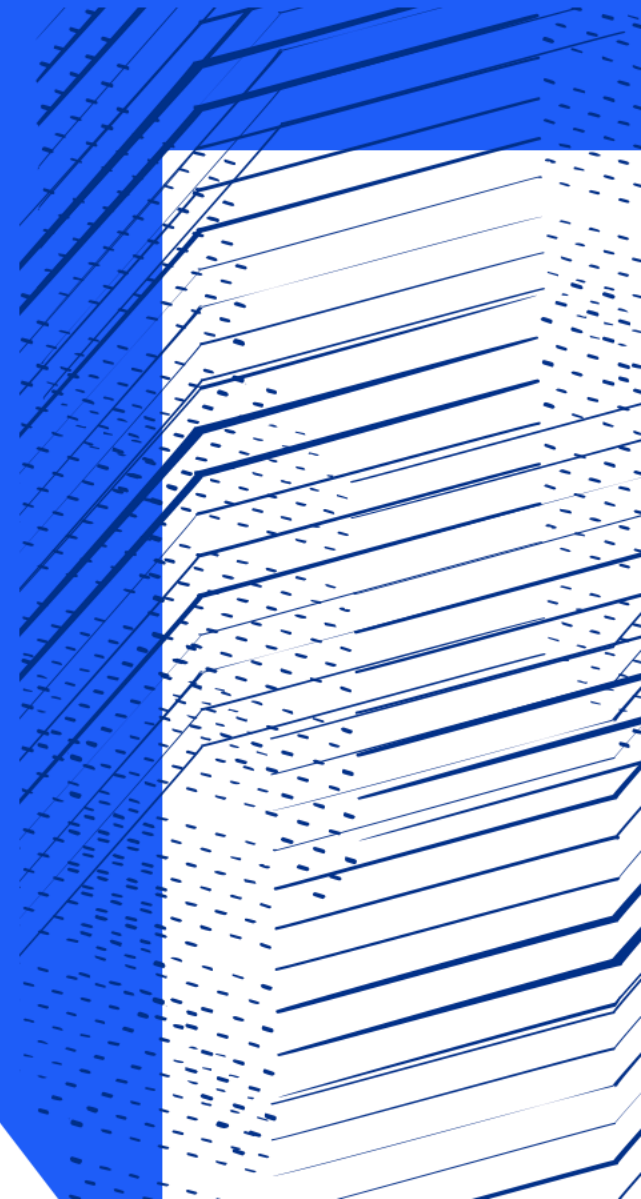




Science and
Technology
Facilities Council

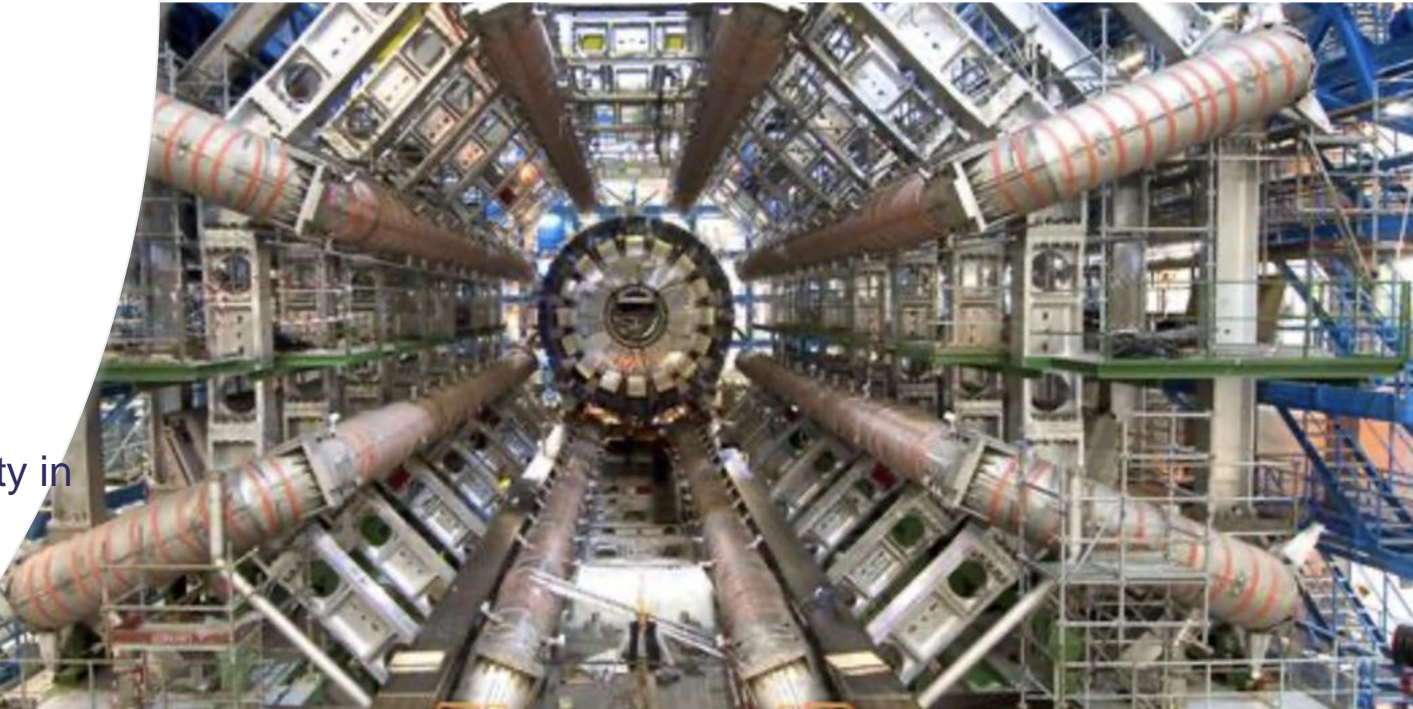
Particle Physics Department

Sinead Farrington



What is PPD

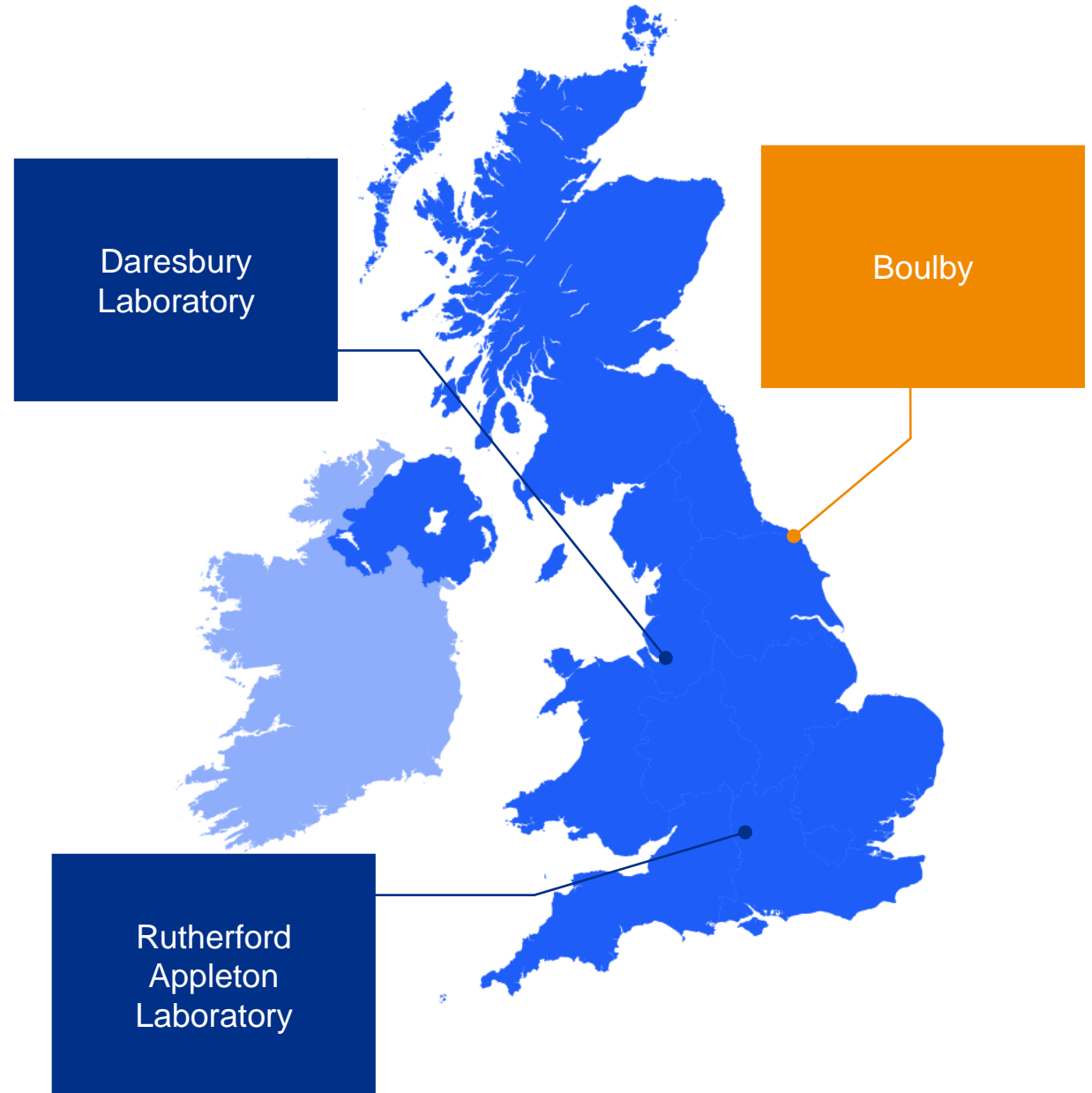
- ~100 staff, many permanent
- ~56 senior scientific staff
- ~5 senior joint with universities
- ~19 postdoctoral staff
- ~20 PhD students
- ~7 project manager experts
- ~6 program support staff
- Underpin UK Particle and Astroparticle physics
 - Construction of experiments and upgrades
 - Computing infrastructure and software
 - Exploitation and operation
 - Project management
 - UK community role (technical and admin)
- Operating the only deep underground research facility in the UK through ~20 FTE staff based in Yorkshire
- Staff based at CERN, (Japan, USA) to construct and operate experiments



PPD Locations

STFC Rutherford Appleton Laboratory
Boulby Underground Laboratory
STFC Daresbury Laboratory

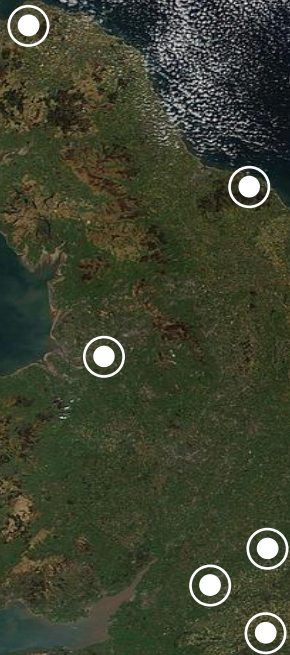
Internationally: several staff in CERN, US, Japan



National Lab context

- [Accelerator Science and Technology Centre](#)
- [Central Laser Facility](#)
- [Hartree Centre](#)
- [ISIS Neutron and Muon Source](#)
- [National Quantum Computing Centre](#)
- [Particle Physics Department](#) including [Boulby Underground Laboratory](#)
- [RAL Space](#)
- [Scientific Computing Department](#)
- [Technology Department](#)
- [UK Astronomy Technology Centre](#)

STFC sites across the UK



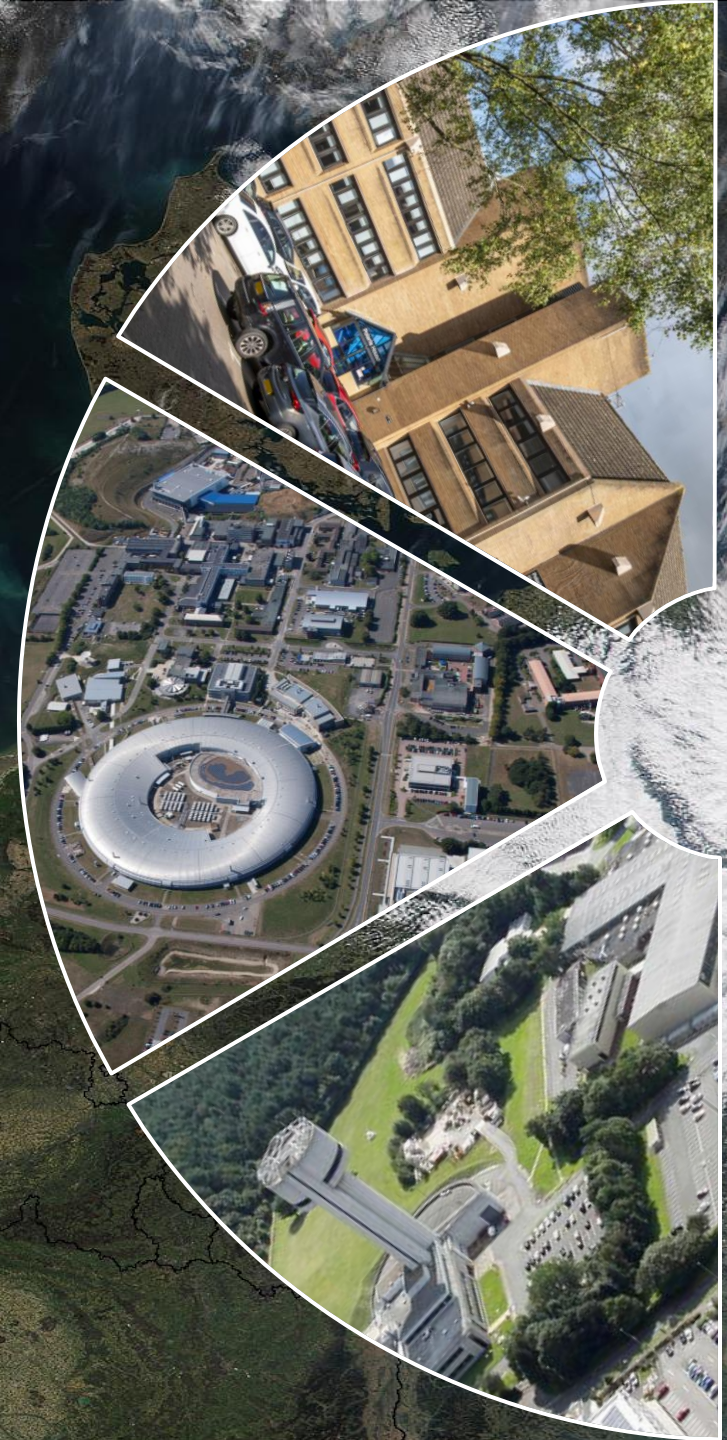
Science and
Technology
Facilities Council

STFC sites across the UK

Rutherford Appleton Laboratory

near Didcot, Oxfordshire

- ~2300 STFC staff
- International multidisciplinary research infrastructures and facilities
- Harwell science & innovation campus – 7500+ people and 220+ businesses
- Clusters – Space, Energy, Quantum, HealthTec, Defence



STFC sites across the UK

Daresbury Laboratory

in the Greater Liverpool City Region

- ~700 STFC staff
- Internationally-renowned engineering, cryogenics and e-infrastructure expertise
- SciTech Daresbury campus – 2000+ people and 160+ businesses
- Clusters – Digital, HealthTec, Space



STFC sites across the UK

UK Astronomy Technology Centre

at the Royal Observatory, Edinburgh

- ~130 STFC staff
- Centre of excellence for the development of scientific instrumentation and facilities for ground- and space-based astronomy
- Higgs Centre for Innovation – £23M investment raised, 26 companies incubated over six years



STFC sites across the UK

Boulby Underground Laboratory

Saltburn-by-the-Sea, North Yorkshire

- ~15 STFC staff
- UK's deep underground science laboratory
- 1.1km underground in a working salt mine
- A unique environment for multidisciplinary science: almost completely free from background radiation



STFC sites across the UK

Chilbolton Observatory

Hampshire

- ~5 STFC staff
- Meteorological measurements
- Radio and microwave propagation experiments
- Satellite tracking and communication



STFC sites across the UK

Polaris House

Swindon, Wiltshire

- ~110 STFC staff
- UKRI Head Office
- Home to STFC Programmes Directorate and Strategy, Planning & Communications functions
- Management of >£585M STFC budget



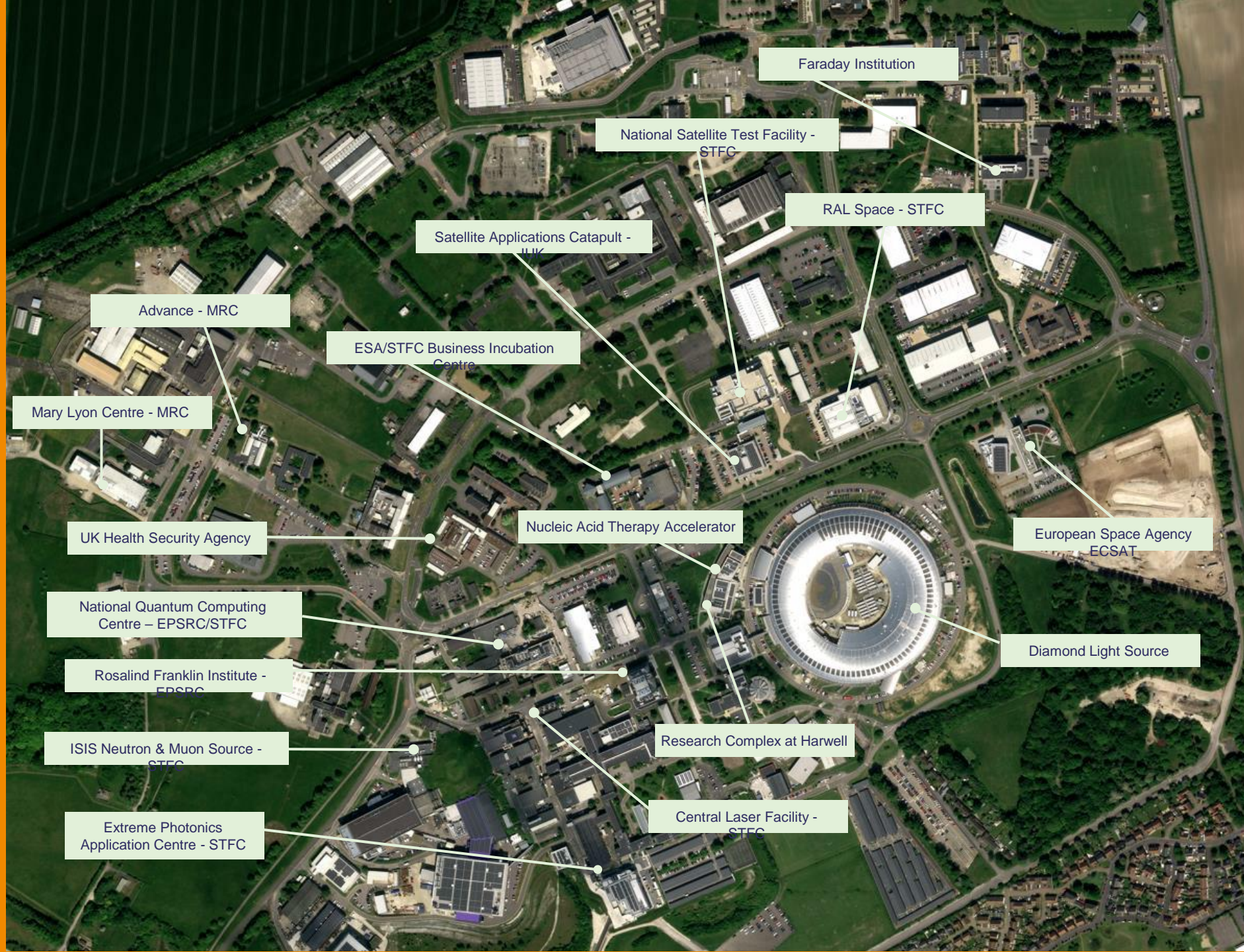
- 700-acre site
- 220+ organisations
- 7,500+ people
- 60+ nationalities represented

- Highly connected: 70% of organisations collaborated with another business or facility

- Supporting 'grow-on' and scale-up businesses: over £1.43Bn investment raised & IPOs

- Incubating early-stage businesses: ESA BIC UK has over 92% business survival rate, incubate and alumni companies generate ~£300M GVA annually

- Driving economic growth: over 63% of organisations export products or services



HARWELL

PPD Links with other Departments

Technology Department

- Source of all engineering effort
- Major involvement with ATLAS Upgrades
- Complete outsource for the DUNE APA production
- Runs the microelectronics support centre (MSC), giving us significant resource in terms of software access

Others

- Scientific Computing operates the Tier-1 Computing facility for the UK, funded through PPD and Programs directorate for 17FTE
- ISIS has previously hosted the MICE experiment, but is now also hosting our Cold Radon Emanation Facility, as well as the MIGDAL experiment
- RAL Space has formed a close link over activities relating to AION
- NQCC: dilution fridge at Boulby to be twin of one on the surface at RAL

UK Particle Physics Program Delivery

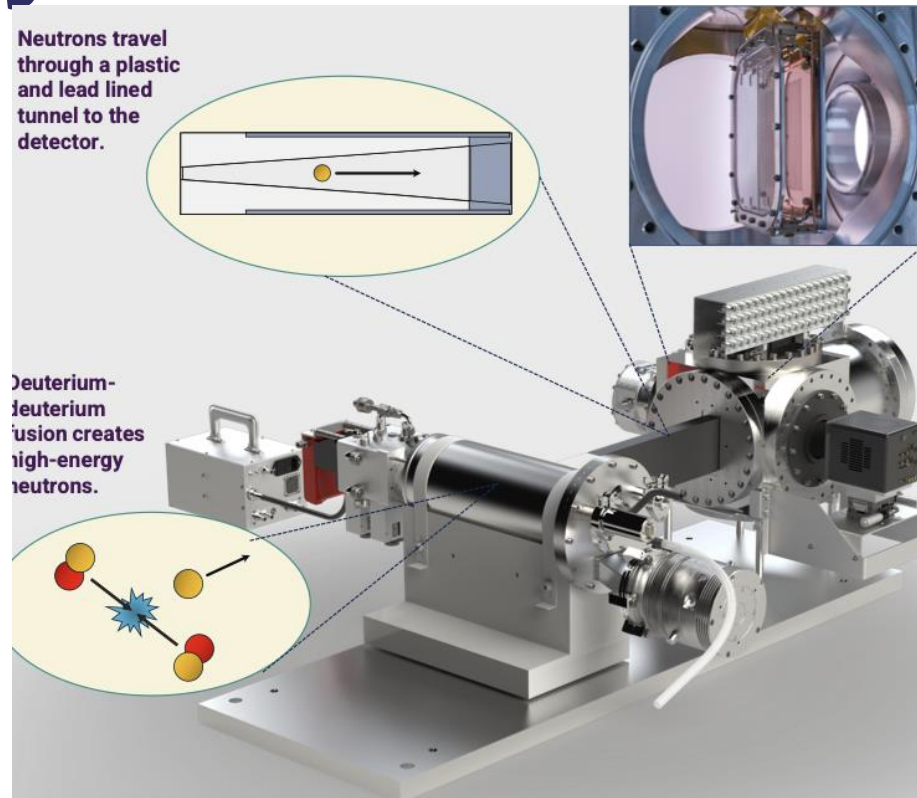
- LHC: (ATLAS, CMS, LHCb)
- ATLAS, CMS upgrades
 - large-scale silicon detector, software, readout, calorimeter
 - Also LHCb upgrade R&D
- DUNE and HyperK
- Dark matter detectors and underground lab
- Computing (UK WLCG contribution)
- Small scale R&D
 - Maintains our skills base and in some cases delivers science in R&D
- Exploitation of the data; maintenance and operations

Engineers all reside in the Technical Department

Some computing staff in Scientific Computing Department

Delivery includes *ideas* (just two examples...)

Migdal



AI ML on FPGAs

What we do

Facilities

- Cold Radon Emanation Facility (CREF, including a warm replica at Boulby)
- Boulby Underground Germanium Screening (BUGS)
- Total owned lab space near 500m², including a small workshop, computing infrastructure, a small cleanroom, a dark lab
- Another ~250m² of cleanroom operated through TD, providing for all kinds of electronics assembly and testing

Interesting equipment available

- Laser equipment for LGAD testing, currently measuring to less than 10ps jitter
- X-ray irradiation facility for ASIC irradiation
- Wafer probing facility
- TCAD infrastructure (Compute with >128GB RAM) – complex 3D simulation capability
- Climate chambers to large sizes (m³)
- Equipment to support all forms of electronics testing

Skills

- Silicon construction (typically some construction and often national integration): currently ATLAS ITk, EIC, some LHCb R&D
- Many with an electronics and software background, e.g.:
 - Wafer probing
 - FPGA programming
 - GPU (and general accelerator) programming
 - TCAD simulation
- Two large Trigger groups (ATLAS and CMS)
- Magnetic shielding to lowest fields from nEDM heritage
- Many with 20+ years in the field providing:
 - UK Principal Investigators for various experiments (ATLAS Upgrade, CMS)
 - International Project leads (ATLAS Strip Upgrade [<10 y post-doctorate], LHCb RICH)

Vision – a work in progress

- Caveat: I want to set a strategy that engages
 - The expertise in the department in its own future “Director’s Discussions”
 - The community in PPD’s future: University head of group discussions
- That said, my vision for PPD:
 - Hub of expertise in particle physics technology (hardware, software, operation, exploitation, project management)
 - Maintains and builds unique capability, distinct from universities – plan staffing needs wrt future projects
 - In partnership with universities – strategic secondments, CASE studentships, Industrial liaison
 - PPD puts its expertise to use in novel areas (quantum, AI)
 - And in doing so, opens unique intellectual opportunities in quantum science onsite
 - PPD: STFC’s in-house experts in particle physics exploitation, technology and project management
 - To be a strong and clear voice on the UK vision for international PP, influencing future collider choices, and to positioning the UK for leadership in future PP experiments.
 - To be host to a fully funded and operational international facility, housing an international dark matter experiment and quantum experiments at Boulby.
 - To be a strong partner in a network of national labs hosting science on their own sites in addition to collaborating in international facilities overseas

Opportunities

- PPD – working with other national lab departments – has capabilities to deliver on STFC and national strategies on AI, Quantum...
- European Strategy Particle Physics Update 2025 (SF in ESG as RAL rep along with two others from UK)
 - Future collider: majority of PPD expertise: DAQ, silicon, calorimeter, software and more: workforce question for 10-15 years from now
 - UK community has the lead in quantum experiments – how to maximise this?
 - Site of next DM experiment?
- Boulby: UK proposes to host largest scale “rare observatory” international experiment XLZD – rule in or out large class of most likely DM candidates among other science
 - With many opportunities beyond (quantum, geology...)
- On-campus science: ISIS (neutrinos, kaons), Migdal... other table-top experiments? (quantum?)
- A new director is a new opportunity to look at our interaction with universities – on-campus presence (sabbatical? Secondment?); large and small scale project formation,

Discussion?

- Delivery of projects – on time and on budget
- National coordinated effort on outreach? (while maintaining each institute identify as a matter of priority)
- National list of equipment
- National training program pooling lab and universities' expertise
- How does your department interact with PPD and are there ways you'd like to change that?
- Interact with other national labs?



Science and
Technology
Facilities Council

Thank you



Science and Technology Facilities Council



@STFC_matters



Science and Technology Facilities Council

Science at Boulby workshops

Bioscience@Boulby

workshop: <https://indico.stfc.ac.uk/event/1058/>

Quantum@Boulby

Workshop: <https://conference.ippp.dur.ac.uk/event/1372/>

Also [Geoscience@Boulby](#)

What we do

Experimental involvement

- CERN based: ATLAS, CMS, LHCb, Faser
 - Including the ATLAS Strip Upgrade PI, the UK ATLAS Upgrade PI, CMS PI until recently, LHCb RICH PI
- Neutrinos: DUNE, Hyper-K/Super-K/T2K, TD produces targets for all
- Dark Matter: XLZD, LZ, Darkside-20k, MIGDAL
- Other: EPIC (@EIC)

Development activity

- Liquido/Cloud, investigating novel neutrino detection
- ASIC and sensor design: 28nm amplifiers for LGADs (through TD), LGAD industrial development (currently showing <10ps timing resolution), flexible CMOS investigations
- AION – participation in development of Atom interferometry in collaboration with MAGIS
- Muon collider