

# Particle Physics Department (PPD) STFC Rutherford Appleton Lab

Stephen Haywood

# Mission

- ❑ **studying the fundamental constituents of matter and their interactions** by designing, building and executing world-leading experiments, in partnership with the UK particle physics community, and by analysing and interpreting results from these experiments
- ❑ **performing world-leading research and development in areas closely related to the UK particle physics programme**, such as particle accelerators, computing and particle physics detectors in collaboration with the UK particle physics community
- ❑ **ensuring the efficient use through effective management of the resources allocated by the Science and Technology Facilities Council** on behalf of the UK particle physics community
- ❑ **supporting the UK particle physics community** through close collaboration, and through the provision of facilities and technical expertise within the STFC Rutherford Appleton and Daresbury Laboratories
- ❑ **designing and developing appropriate technologies for particle physics** in partnership with industry, being alert to opportunities for their wider application, thus contributing to the UK's economic competitiveness and the quality of life
- ❑ **working with other stakeholders to develop the future UK particle physics programme**, and providing vision, leadership and strategic advice
- ❑ **promoting public understanding, education and training** in the field of science

# Mission

- Designing, building & executing **experiments**; analysing results
- **R&D** in detectors, accelerators & computing
- Management of STFC **resources**
- Provision of **facilities & expertise** for UK-PP
- Developing technologies with an eye to wider **UK needs**
- Working with stakeholders to develop **UK-PP programme**
- **PUS**, education & training

# Mission

- World-leading
- Research
- In partnership with UK-PP (Universities)

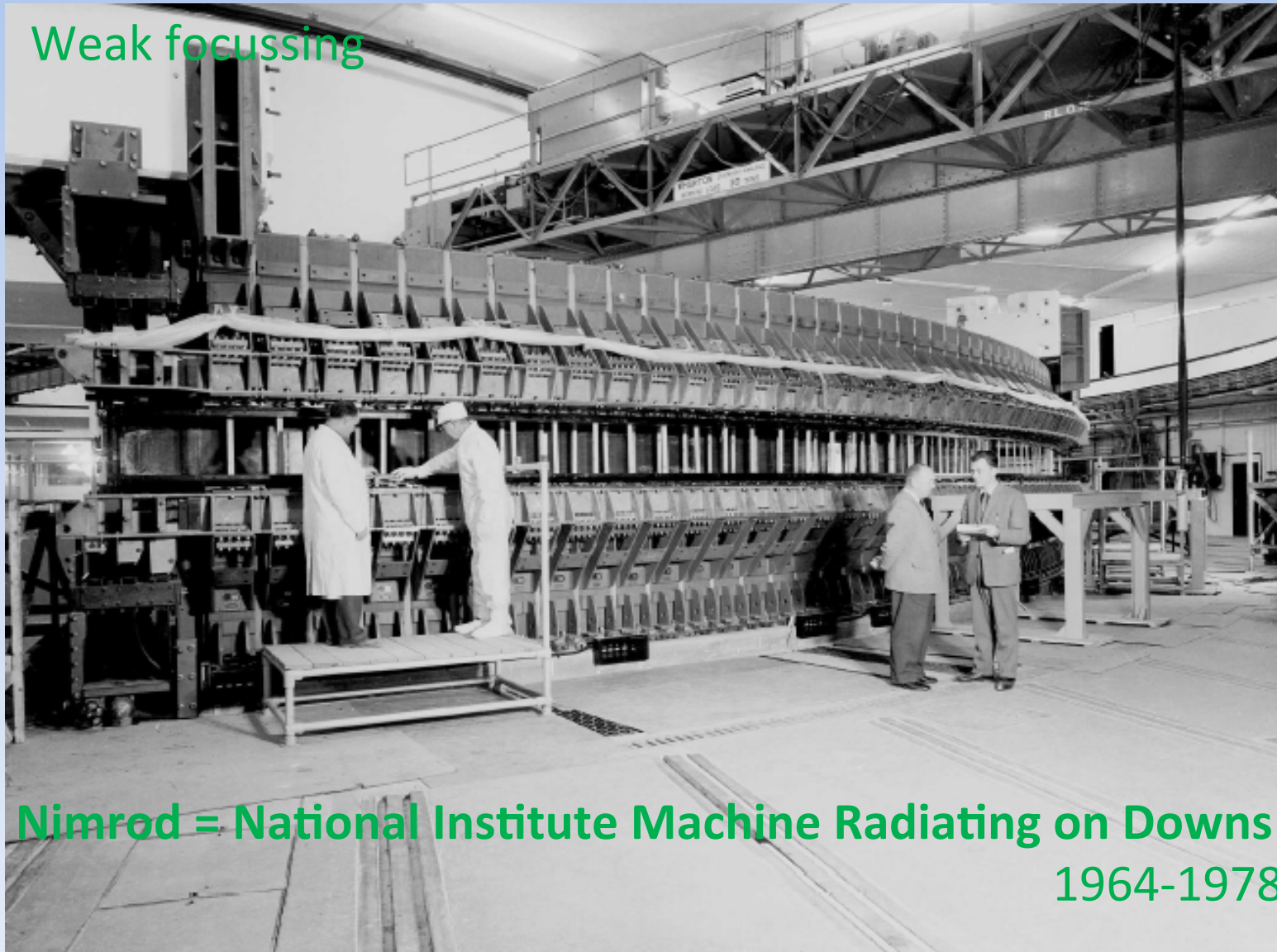
Where the UK goes, RAL goes

- supporting UK University academics
- providing leadership on behalf of UK, where appropriate



# RHEL & Nimrod

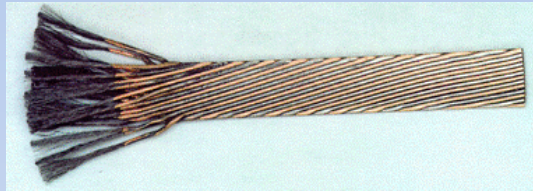
Weak focussing



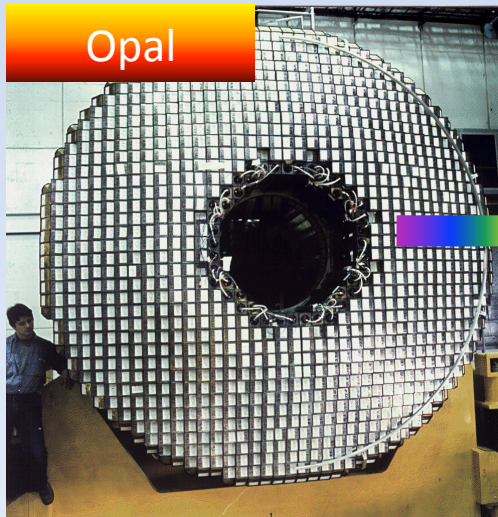
**Nimrod = National Institute Machine Radiating on Downs**  
1964-1978

# RAL Inventions

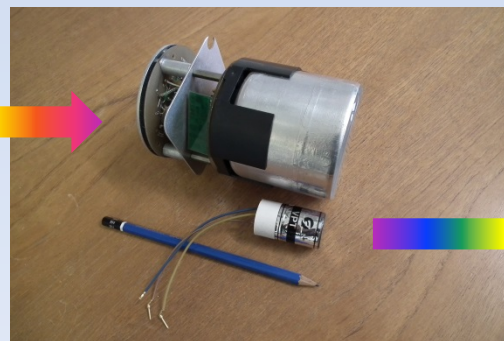
Rutherford Cable



Opal



VPTs



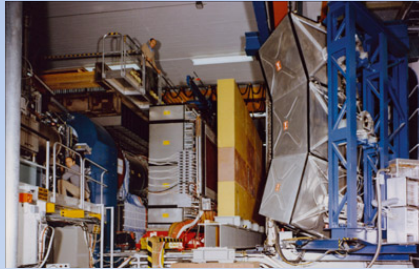
CMS



# Past Experiments

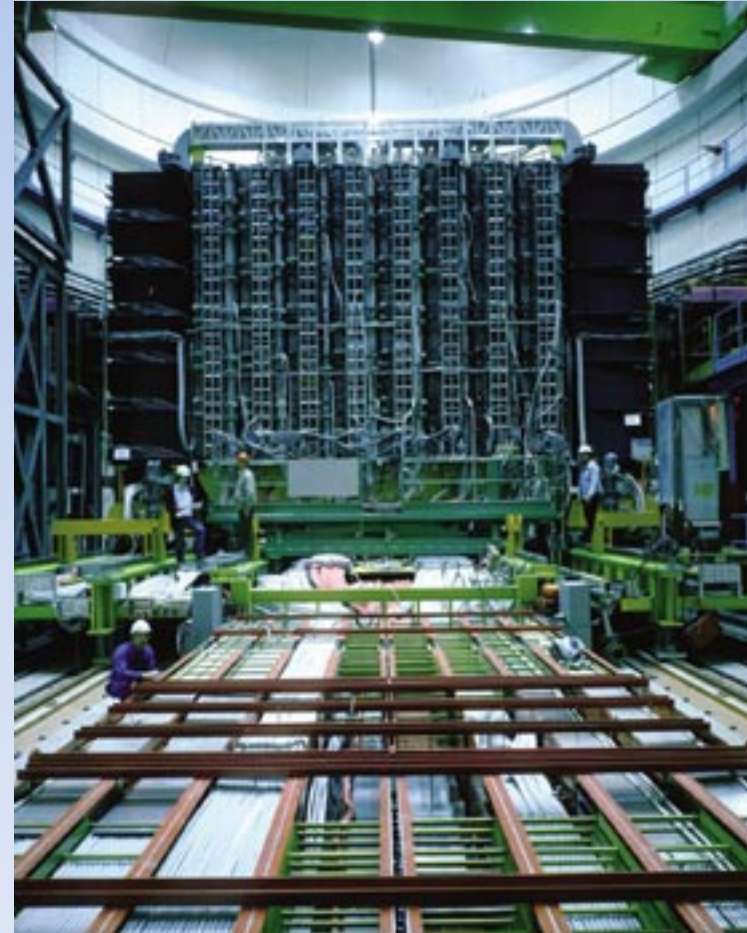
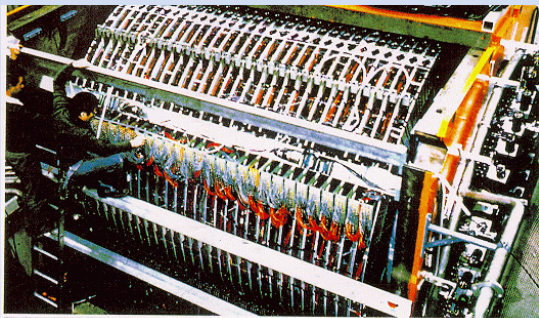


Bubble chambers



ISR

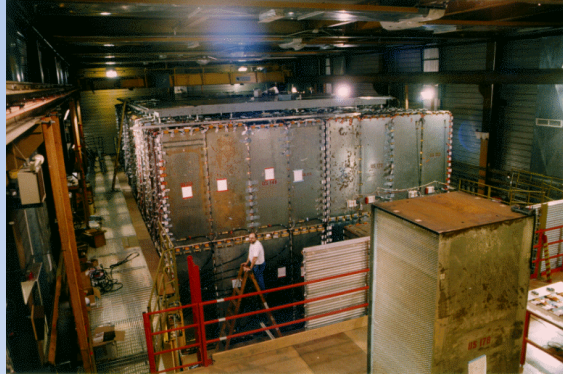
Petra



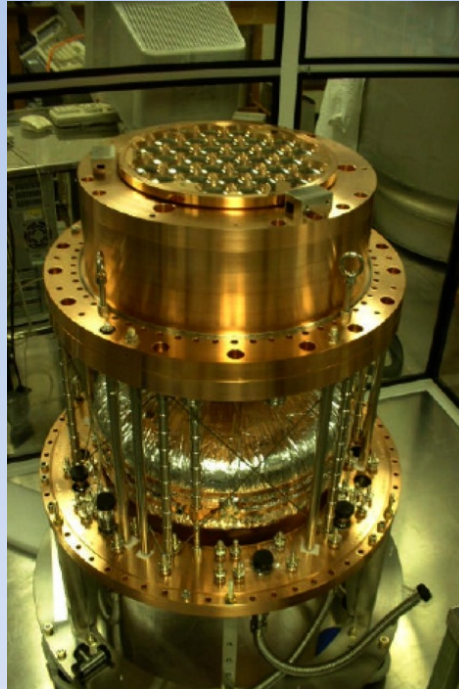
UA1 – Hcal



# Past Experiments



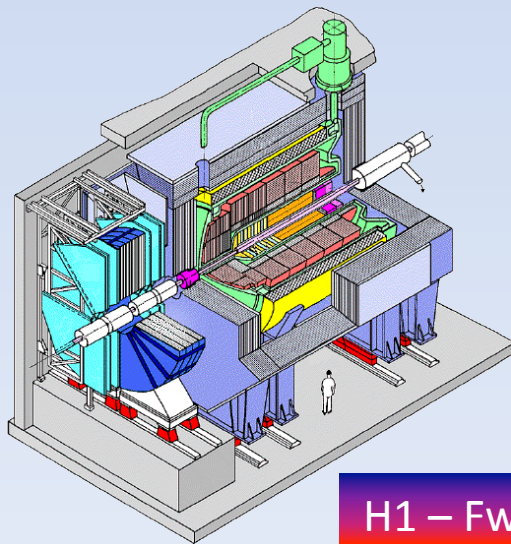
Soudan



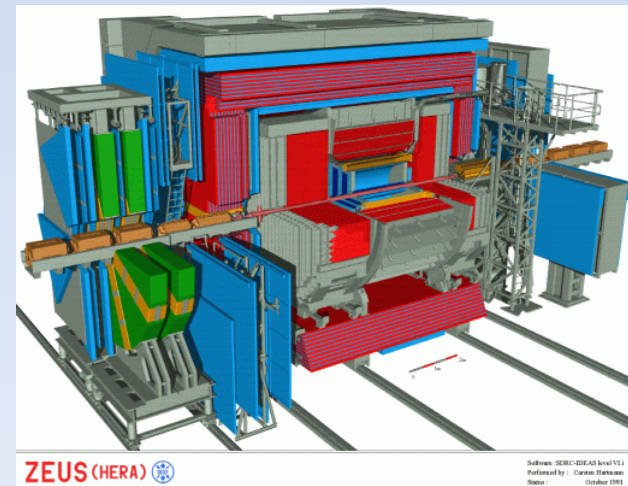
Zeplin 1, 2 & 3



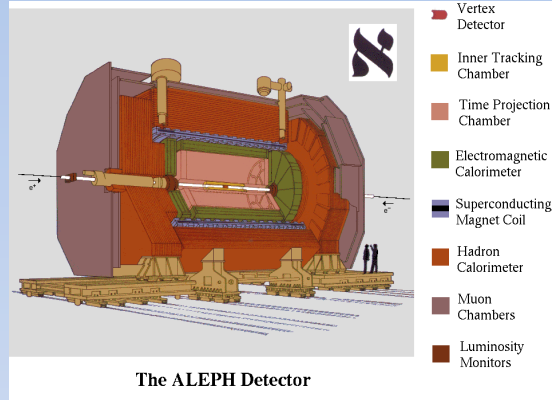
Minos



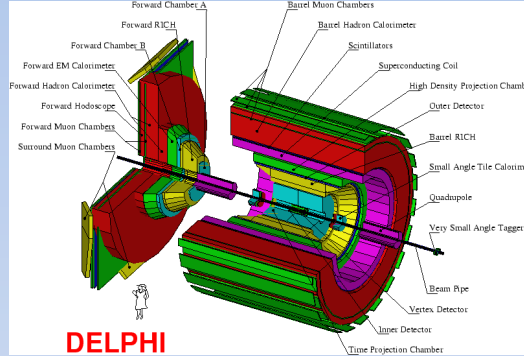
H1 - Fwd Tracker



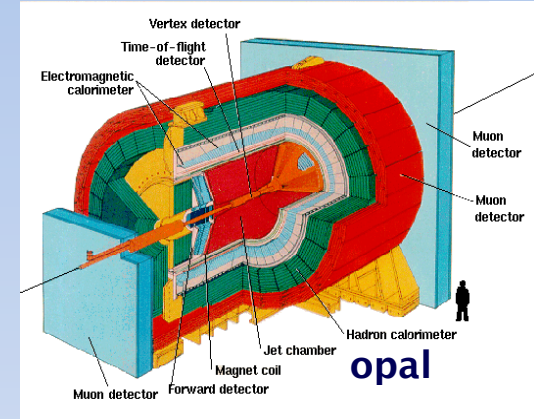
# Past Experiments



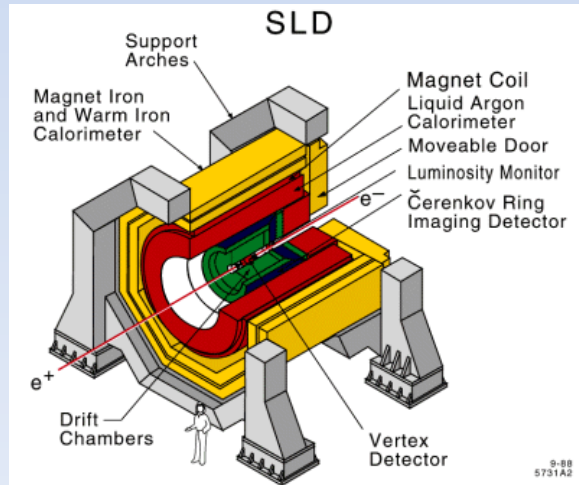
Aleph – Ecal EC



Delphi – Vtx Det

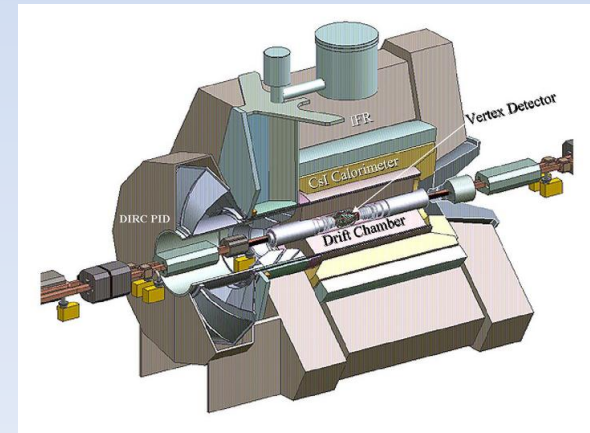


Opal – Ecal EC



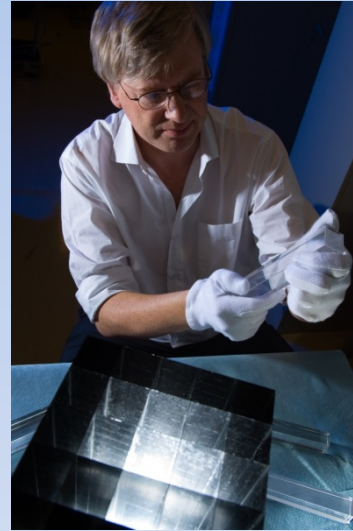
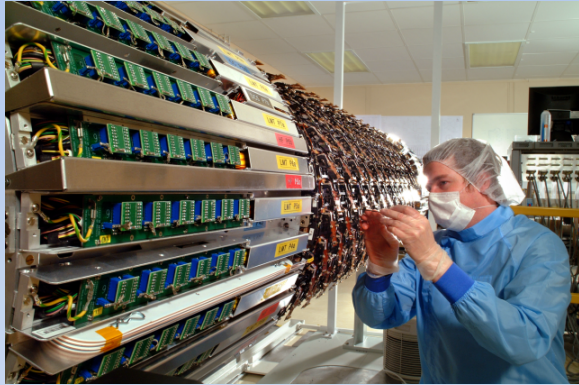
SLD – Vtx Det

BaBar – Trigger



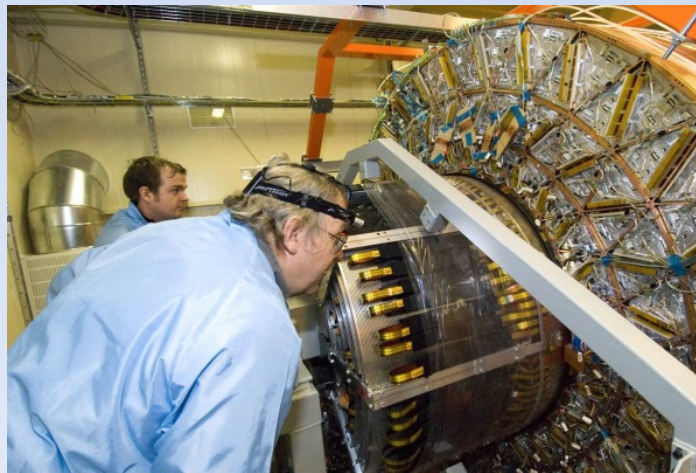


# PPD Contributions



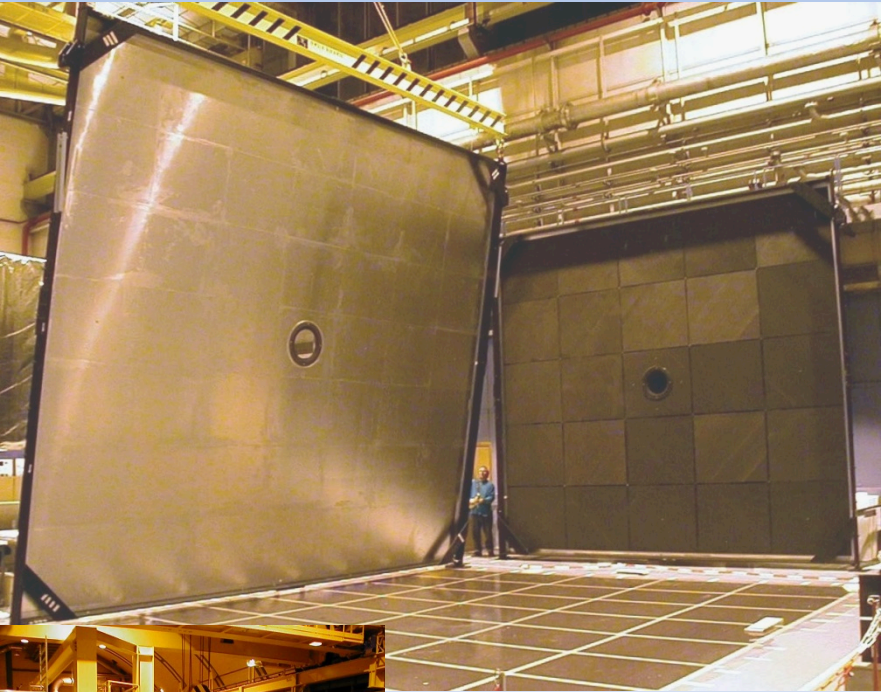
ATLAS Tracker & Trigger

CMS – Ecal EC

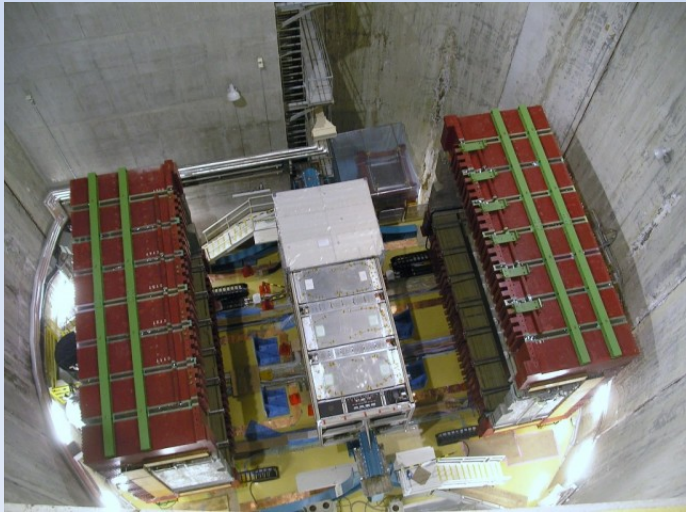
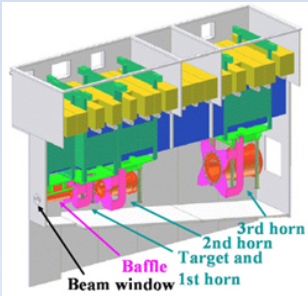


LHCb – RICH

# PPD Contributions



T2K – DAQ



T2K – Target

Stephen Haywood



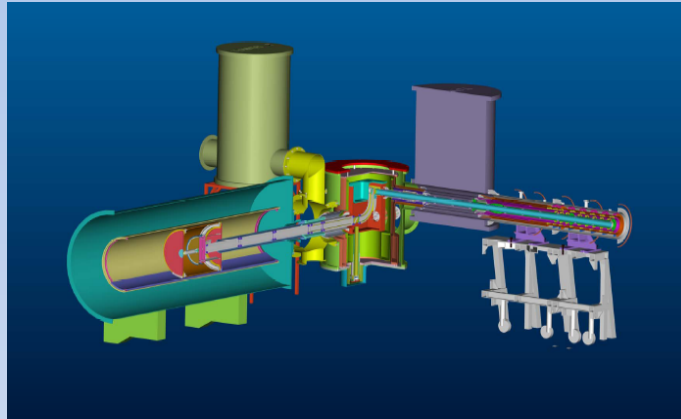
Particle Physics @ RAL



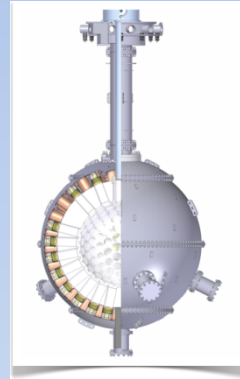
RECFA 13

# PPD Contributions

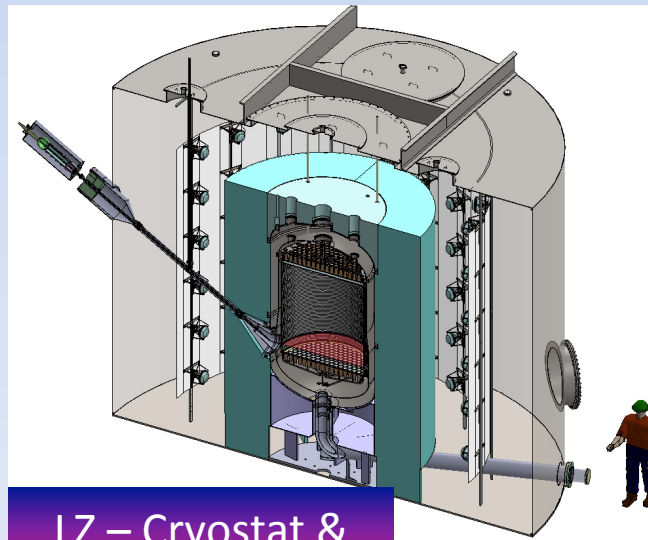
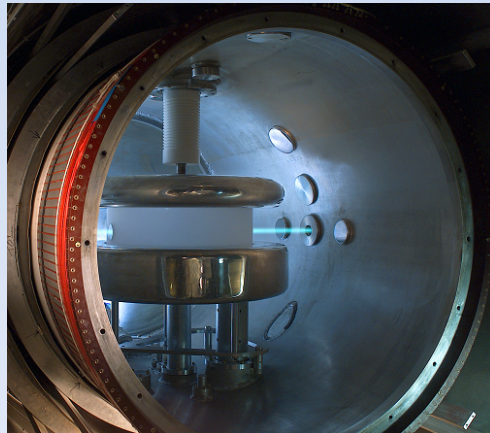
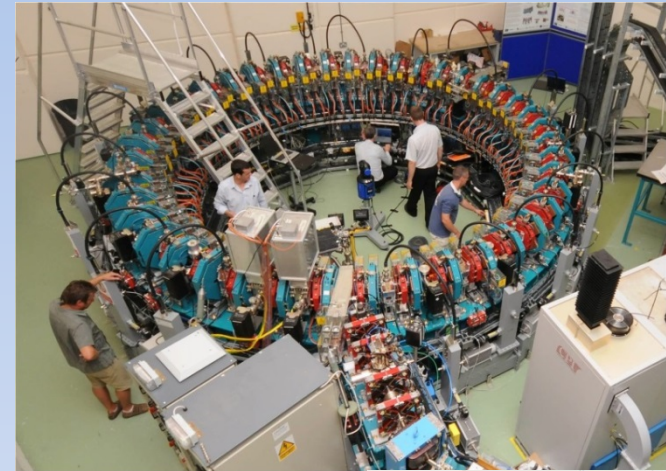
EMMA



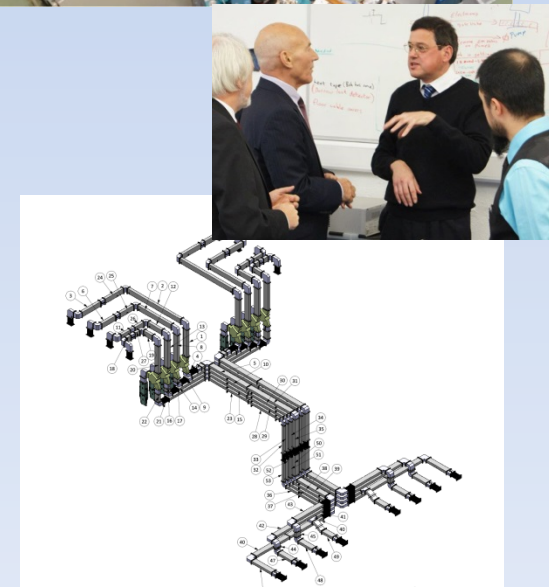
CryoEDM



DEAP - Calib

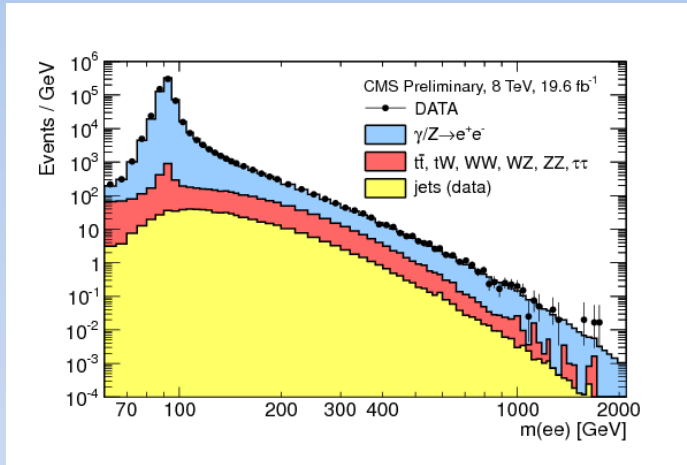


LZ - Cryostat & Calib

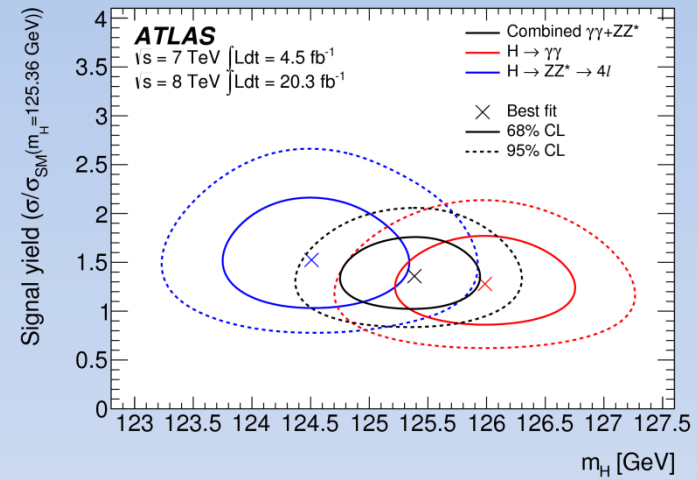


ESS

# ... and Analysis and Computing



CMS – Z'



ATLAS – Higgs



UK Tier-1



UK-South Tier-2



# Portal to STFC

- Access to **Technology Department (TD)** @ RL, DL & ATC
- **STFC Computing**, esp RAL Tier-1 & Tier-2
- Other departments: **CLF** (Lasers), **ISIS** (neutrons)
- STFC **Logistics** (transport)
- STFC **Administration**, esp Finance, Legal



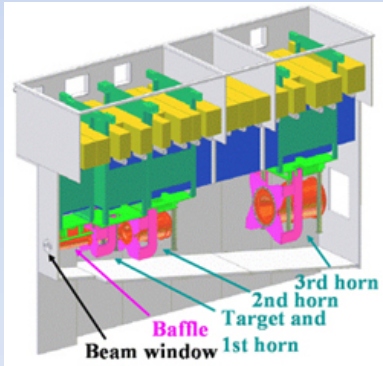


# TD Business



Delphi Solenoid

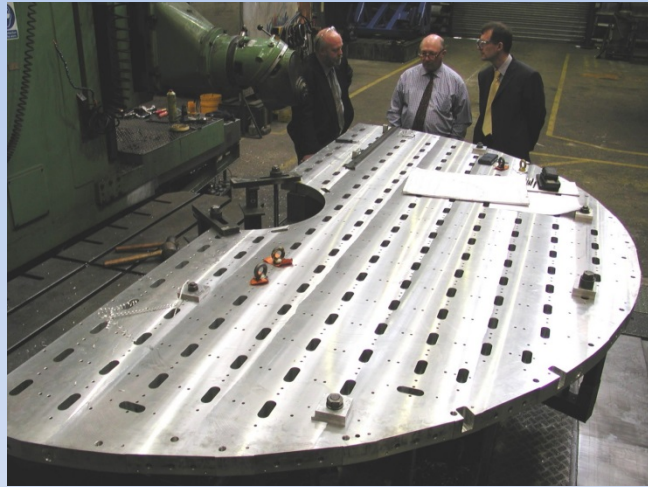
ATLAS EC Toroids



T2K Target

PPD accesses TD effort to initiate **new projects**

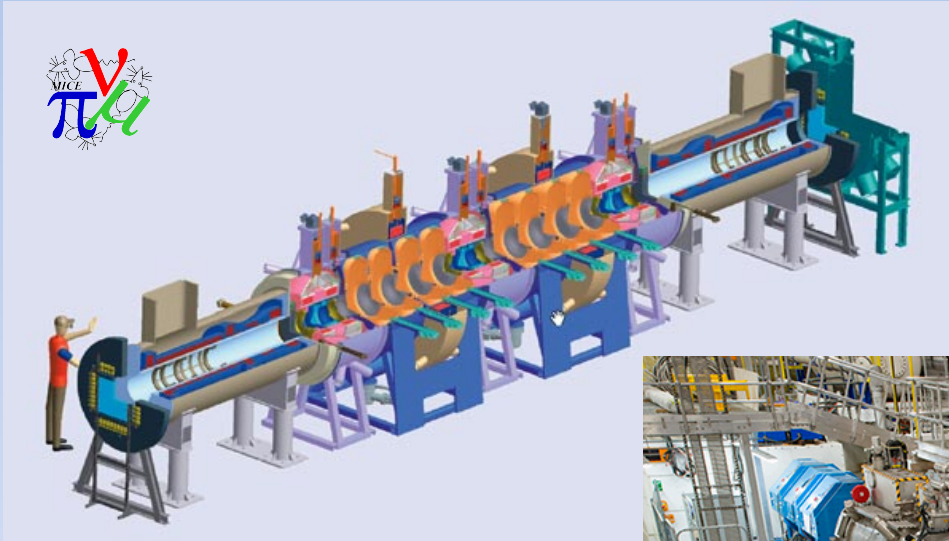
# Industry



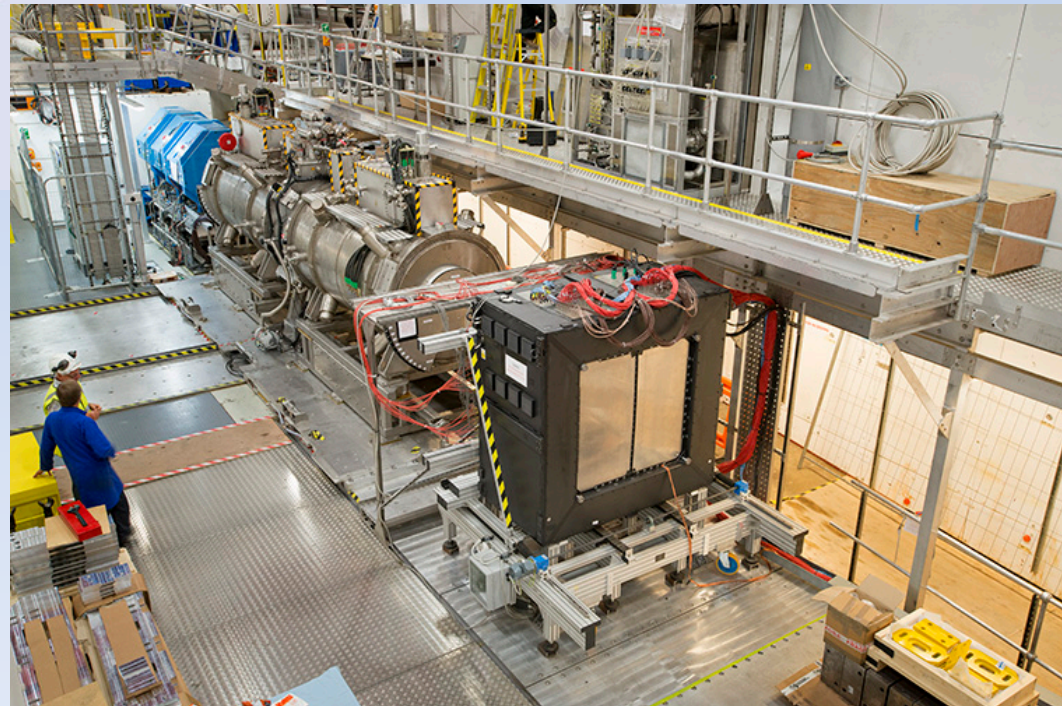
CMS Ecal Endplate

The screenshot shows a web browser window with the URL [www.tmengineers.co.uk/scientific.html](http://www.tmengineers.co.uk/scientific.html). The page features the TM Specialist Engineers logo and the tagline "Passionate About Engineering Excellence". The navigation menu includes: HOME, INDUSTRIAL SECTORS, HEAVY STEEL FABRICATION, LARGE PART PRECISION MACHINING, MACHINING CAPACITY, and CONTACT. The main content area is titled "SCIENTIFIC" and features a section for "HADRON COLLIDER" with the following text: "TM Specialist Engineers was awarded the contract by the STFC (Science and Technology Facilities Council) to Manufacture 4 metre diameter E-CAL End plates for the largest of the four detectors ATLAS at the Hadron Collider." To the right of this text is a large image of the endplate being worked on. Below this is another section for "RUTHERFORD APPLETON LABORATORIES" with a red circle around the title and text: "TM Specialist Engineers was awarded the contract to build The Ladder Chassis and Drive Carriage assembly for Rutherford Appleton Laboratories. The Ladder Chassis and Drive Carriage Assembly is part of a Research and Development Project." This section is accompanied by an image of a long industrial assembly line.

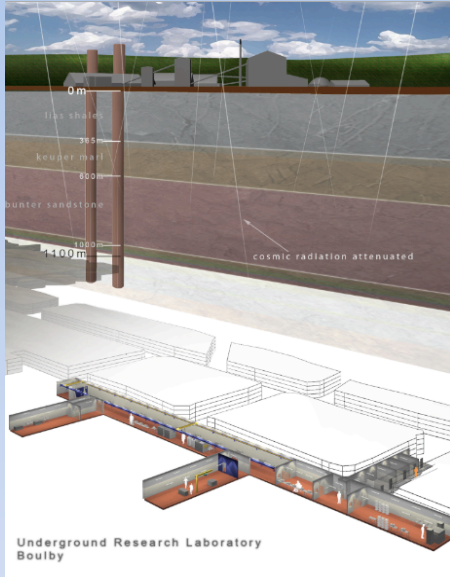
# Facilities – Mice and ...



with  
TD, ISIS, ASTec



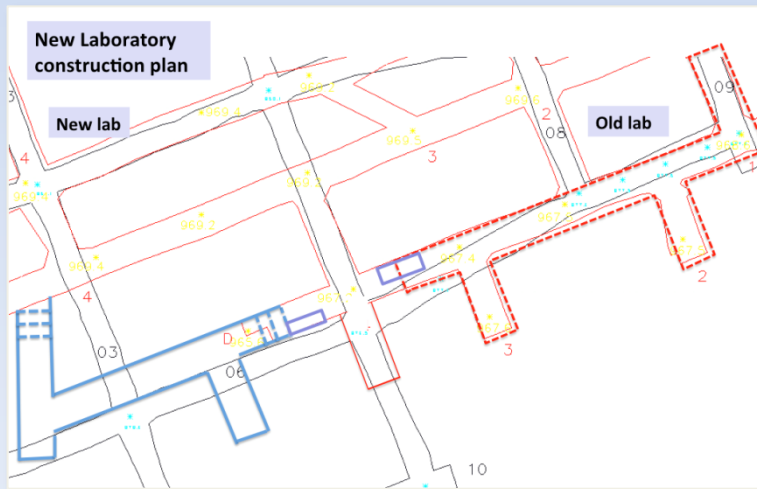
# Facilities – Boulby



Today



Tomorrow



# Facilities – Boulby


## Dark Matter

- (Zeplin)

-  Drift

- DM-Ice

## And beyond

-  (Sky –Cloud formation)
- Muon Tomography – Carbon capture
- Bisal – Astrobiology, Extremophiles, Space & Mining technology
- Germanium Suite ... SuperNemo, LZ



# Activities

- (RAL Summer School)
- **FPGA Training** with TD
- **CMOS Training** with TD
- **Cosener's Forum** with IPPP (Durham) (annual)
- **NEXT**
- **UKLO**



Science & Technology Facilities Council  
Rutherford Appleton Laboratory

IP3

## UK HEP FORUM: Future Colliders

13-14 November 2014  
The Cosener's House, Abingdon

*A particle physics forum on future colliders*

**Organising Committee:**  
Phil Burrows  
John Ellis  
Valery Khoze  
Alexander Lenz  
Emmanuel Olaiya  
Silvia Pascoli  
Stefania Ricciardi  
Alfons Weber

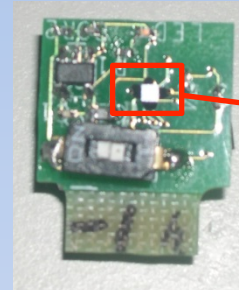
**Secretariat:**  
Jane Bruffell

Registration: <http://hepwww.rl.ac.uk/accel/forum>

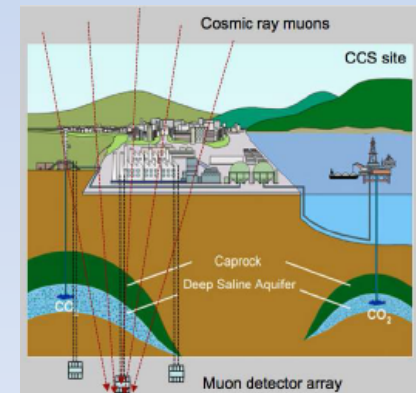
UK PhD students are invited to present their work in the form of a poster

# Knowledge Exchange / Impact

- In-vivo dosimetry
- Power transmission
- Accelerator applications, eg hadron therapy
- Cancer treatment programmes
- Boulby:
  - Muon tomography for Carbon capture
  - Cloud formation
  - Life in extreme environments



1 mm x 1mm ASIC



# PUS & Education

With STFC **Public Engagement Team**

- **Masterclass**, with help from ISIS & DLS (800 pupils)
- Many **visitors** – talks, Show ‘n’ Tell
- Royal Society Ex – with UK-PP
- Big Bang Ex – with UK-PP
- **Schools** & other public talks
- **Boulby** area
- RAL **Open Days** – July 2015
- 2014: 10 **Summer Students** (undergrad);  
9 **Work Experience** students





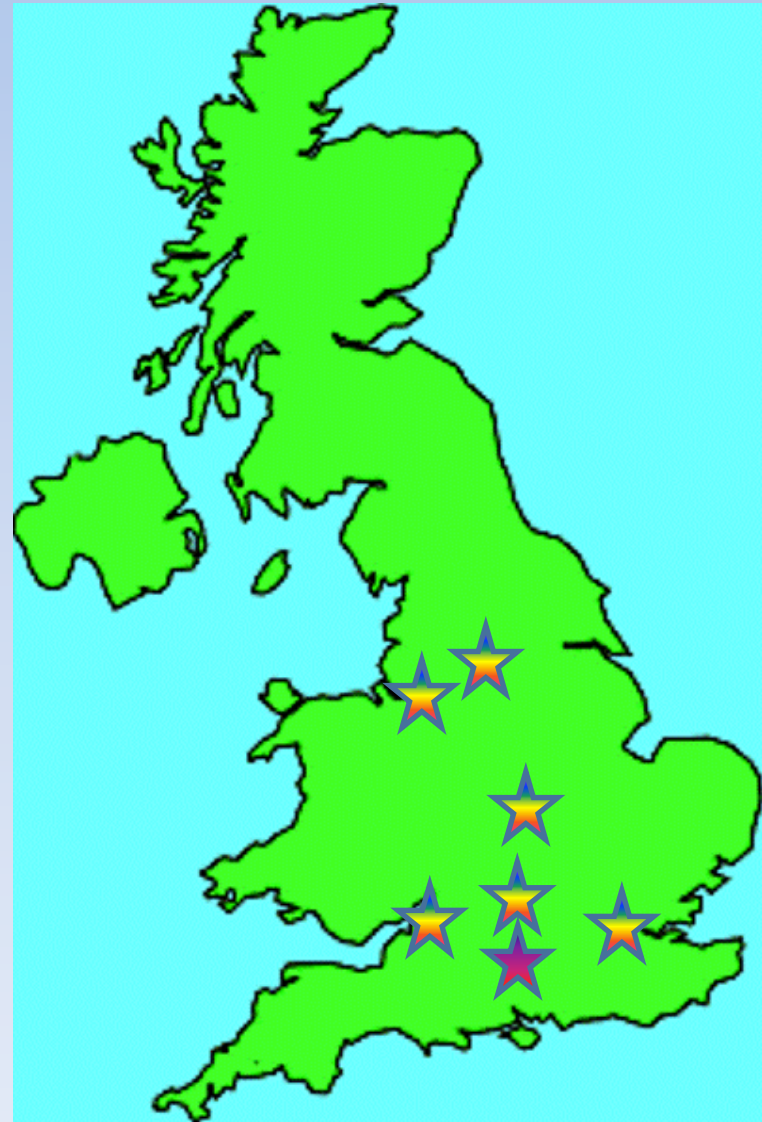
# Who are we ?

- ~76 **staff** (68 FTE\*) – 2/3 have PhDs, 34 Academics
- 6 very active **emeritus** professors
- ~6 PPD PhD **students**, 3 Masters students + visiting/  
resident students
  
- 9 **Joint-appointments** with UK Universities
- Few others also **teach** (London, Durham, Oxford,  
Soton, Warwick, STFC Summer School) + Student  
supervision
- **Visiting Fellows**

\* 51 FTE directly funded, plus GridPP, Mice, Projects, Programmes, Astec, Other

# Joint Appointments

- Andreopoulos →Liverpool T2K
- Boyd ←Warwick
- MICE Ops
- Edgecock →Huddersfield Accelerators
- Long ←Imperial MICE
- Newbold ←Bristol CMS Trigger
- Nikkel ←RHUL LAr R&D, LZ
- Murray →Warwick
- ATLAS Analysis
- Wark →Oxford Director, T2K
- Weber →Oxford T2K, LBNE/F



# Current/Recent Leaders



Murray  
ATLAS Physics



McMahon  
ATLAS Tracker

Tyndel  
ATLAS Tracker



Petyt  
CMS Ecal



Papanestis  
LHCb RICH



Wark  
T2K



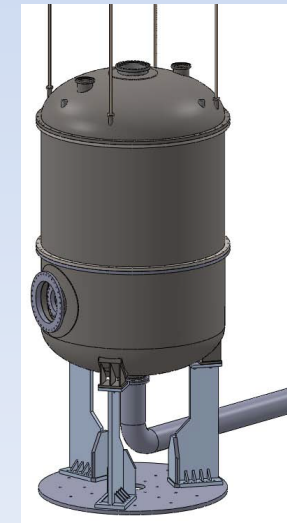
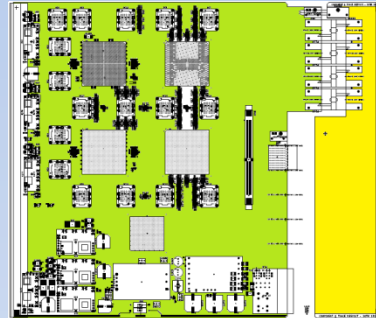
McCubbin  
ATLAS Computing



# Future

- ATLAS Upg – Tracker, Trigger
- CMS Upg – Trigger
- LHCb Upg – RICH
- MICE
- T2HK – DAQ ?
- LBNE/F
- LZ – Cryostat, Calibration
- ILC
- SHIP – Magnet design (TD)

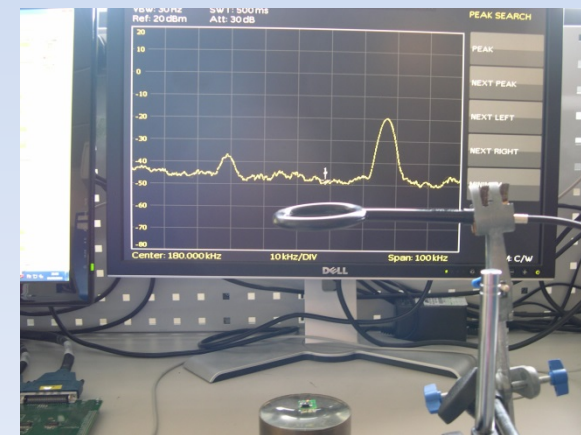
Open to **new projects** in support of UK-PP  
(eg LSST?)



# Supporting the Community

Expertise beyond well-defined collaborations:

- Silicon Tracking
- Photodetectors
- Trigger & DAQ
- Computing (GPUs)
- New Initiatives programme



# Conclusions

## PPD

- Vibrant and successful group, extensive range of **academic, technical, computing and proj man** skills
- Provides unique support & access for the **UK-PP Community**, working with
  - **STFC & esp STFC Technology**
  - **UK Universities**
  - **CERN & International parties**
  - **Industry**
- Demonstrates value of significant, in-house research activity based in **National Lab**







# Funding

- **Staff** funding = £3.1 M
- **Operations**, Joint Appointments, Fellowships,  
New Projects = £0.6 M
- **Programme Support** = £0.2 M
- **SLA** (UK Projects) ~ £13 M