



# High Energy Particle Physics Town Meeting 2013

Professor John Womersley  
Science and Technology Facilities Council

10<sup>th</sup> April 2013

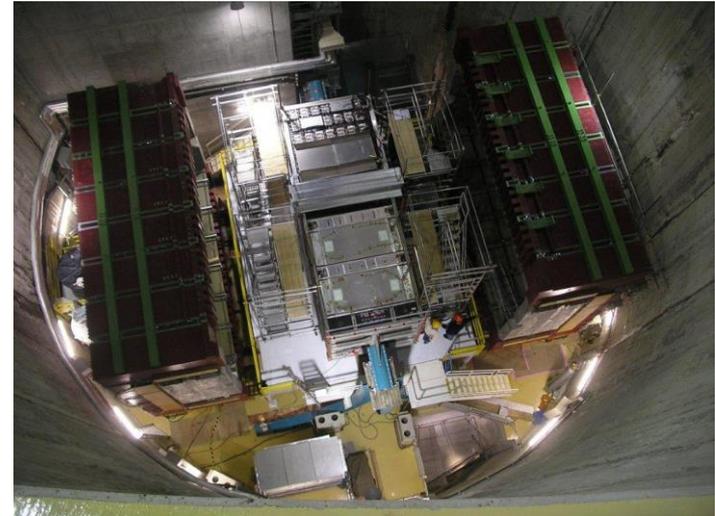
# Outline

- **Updates on the UK Programme**
- European Particle Physics Strategy
- STFC Updates
- Spring Budget, Spending Review, Triennial Review



# Particle Physics

- Our highest priority in particle physics is the exploitation of the **Large Hadron Collider** at CERN.
  - **ATLAS, CMS** and **LHCb** (and ALICE) experiments
  - **GridPP**
- Exploring neutrino mass and mixing with **T2K** and **SuperNEMO**



# LHC

- The LHC delivered over  $23\text{fb}^{-1}$  at 8 TeV in 2012
  - Machine performance last year broke all records; integrated luminosity delivered exceeded predicted
  - Data analysis and Grid computing resources were able to keep pace
- These data have shed light on some of the biggest science questions, including placing challenging limits on physics beyond the standard model
- Latest physics updates:
  - Higgs results now  $6-7\sigma$ , generally all consistent with SM, and spin-zero confirmed
  - LHCb observes  $B_s \rightarrow \mu\mu$  decay at rate compatible with SM

# LHC Update

- Next steps
  - Long Shutdown 1 started in Feb 2013. Programme is complex and challenging - will take 2 years.
  - Machine restart in 2015 with increased collision energy of 13 TeV and another increase in luminosity.
- Proposals for the UK participation in Phase 1 construction and Phase 2 R&D for ATLAS/CMS upgrades considered in 2012
  - Funding for phase 1 has been approved
  - Phase 2 R&D in part (awaiting programmatic review)
  - Grants issued starting 1 April 2013
  - Concern over scale of the Phase 2 ATLAS/CMS upgrades
- Future participation in the LHCb upgrade will be decided as part of Programmatic Review
  - UK groups have some modest bridging funding to remain engaged with the upgrade R&D programme

# Neutrino Physics

- The international T2K project at JPARC in Japan, in which the UK holds key leadership roles, is a world leading experiment for the study of neutrino oscillations
  - Accelerator, beamline and experiment restored following 2011 earthquake, and began taking data again in Q1 2012.
  - presented new results on electron neutrino appearance from muon neutrinos at 2012 Neutrino conference in Kyoto
  - first single experimental indication that  $\theta_{13}$  is non-zero and large with a  $2.5 \sigma$  level of significance
- We are supporting the Demonstrator phase of the SuperNEMO project, a UK-France led experiment to search for neutrinoless double-beta decay
  - Aim is to demonstrate required sensitivity before a final decision on participation in the detector construction project.

# Particle Astrophysics

- Astroparticle Physics European Consortium – STFC founding member of revised sustainable ApPEC
- In the coming decade we expect to directly detect, for the first time, gravitational waves from distant cosmic phenomena
  - Ground-based Gravitational Waves programme – detector exploitation and future R&D
  - Advanced LIGO
- Review of STFC support for ground-based gravitational waves programme currently underway
- Modest STFC funding for Einstein Telescope R&D (through ASPERA Common Call) and for Max Planck partnership, jointly with EPSRC



# Particle Astrophysics

- STFC awarded funding for a 3 year R&D programme towards Cherenkov Telescope Array (CTA) observatory in high energy gamma
  - places the UK in a strong position to lead the high-energy component of CTA in the construction phase and ensure future access to data for the UK scientific community
- STFC awarded funding for Dark Matter R&D towards the next generation experiments, aligned with Science Board UK DM Strategy:
  - EURECA Development
  - LUX-ZEPLIN Development

# Consolidated Grants

- Existing standard and rolling grant mechanisms have now been replaced by a single consolidated grant scheme
  - Not a major change for Particle Physics
  - Continued support for core posts and R&D and early stage technology development in universities
- 2011 PPGP Theory grants round was one of the first to use consolidated grants mechanism
  - Some points of clarification needed but overall has worked well
  - the next Particle Physics Theory Grants round is now underway.
- Wakeham re-investment will help us to maintain support for this round, though funding remains tight

## Consolidated Grants

- The 2012 PPGP Experiment grants round, which underpins the UK's particle physics research and exploitation programme, completed. Grants announced October 2012
- Strategic guidance from PPAN on need for some additional small scale activities to keep options for the future and some vitality in the programme
  - Flexibility for Grants Panel used to award a small amount of FTE and travel to new activities (or existing activities currently not supported by STFC) where a strong science case made
- Coordinated the consolidated grants round with the ATLAS and CMS upgrade proposals.
- Sharp reduction in STFC capital allocation post-2010 CSR means capital for grants will be limited by available funding
  - Continuing to try to manage impact of reduced capital

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# European Particle Physics Strategy



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September 2012
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Erice  
January 2013
- Strategy Adopted by CERN Council  
March 2013



## European Particle Physics Strategy - 1

The discovery of the Higgs boson is the start of a major programme of work to measure this particle's properties with the highest possible precision for testing the validity of the Standard Model and to search for further new physics at the energy frontier. The LHC is in a unique position to pursue this programme.

*Europe's top priority should be the exploitation of the full potential of the LHC, including the high-luminosity upgrade of the machine and detectors with a view to collecting ten times more data than in the initial design, by around 2030. This upgrade programme will also provide further exciting opportunities for the study of flavour physics and the quark-gluon plasma.*



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*CERN should undertake design studies for accelerator projects in a global context, with emphasis on proton-proton and electron-positron high-energy frontier machines. These design studies should be coupled to a vigorous accelerator R&D programme, including high-field magnets and high-gradient accelerating structures, in collaboration with national institutes, laboratories and universities worldwide.*

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*Europe looks forward to a proposal from Japan to discuss a possible participation.*



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*CERN should develop a neutrino programme to pave the way for a substantial European role in future long-baseline experiments. Europe should explore the possibility of major participation in leading long-baseline neutrino projects in the US and Japan.*



## Organisational Issues

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Particle Physics  
CERN  
Accelerator R&D  
Nuclear Physics  
Science Board  
ESRF, ILL  
Diamond  
Futures  
External Innov.  
Public Engagement  
Education and Training  
ING, JAC

**SUSAN SMITH**  
Head of DL  
  
ISIS  
CLF  
RAL Space  
Technology (UKATC, NPG)  
ASTeC  
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HR  
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**Science & Technology**  
Facilities Council

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# Programmatic Review 2013

- Overseen by Science Board with community input through the advisory panels
- The goal is not to shrink the programme or to fit within a reduced budget
  - *This is a process to optimise our science programme*
  - *Includes both identification of future opportunities and realisation of where science productivity may have passed its peak*
  - *Will include consideration of issues such as fraction of spend on grants vs. projects vs. students*
- Best position ourselves for next CSR



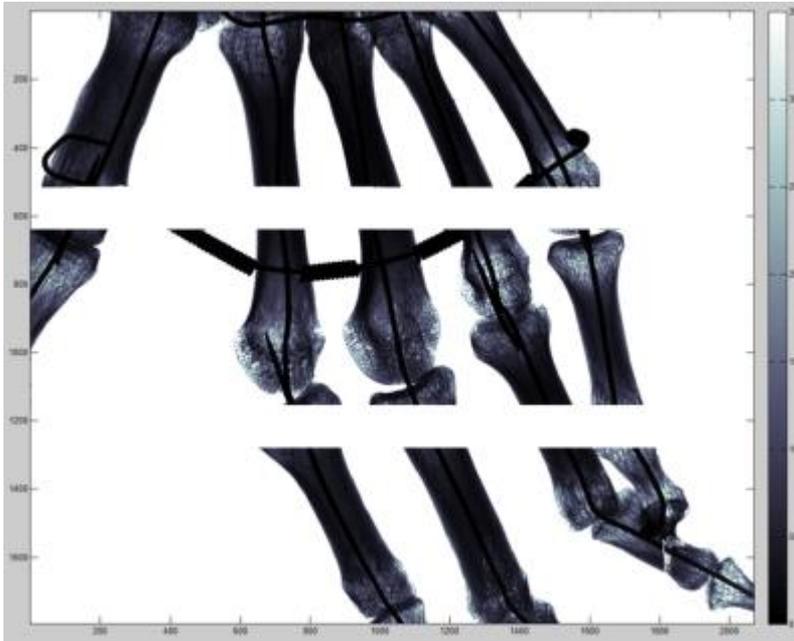
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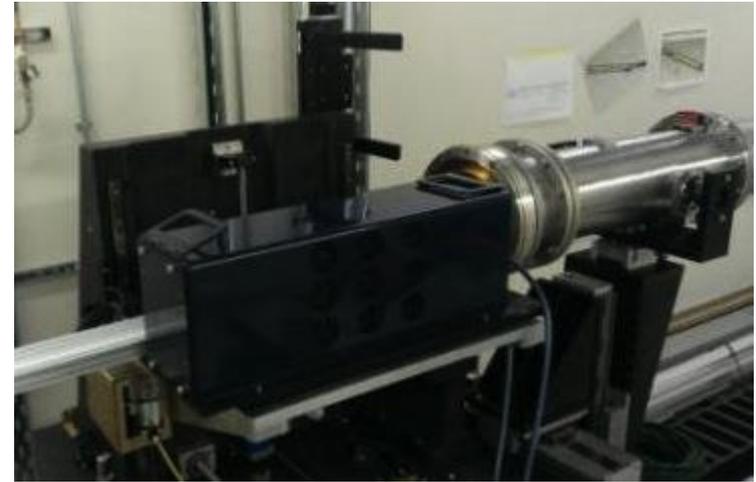


# Technology - EXCALIBUR

- Now installed at Diamond Beam I13
- Three megapixel (Medipix 3 readout)
- 1,000 frame per second system



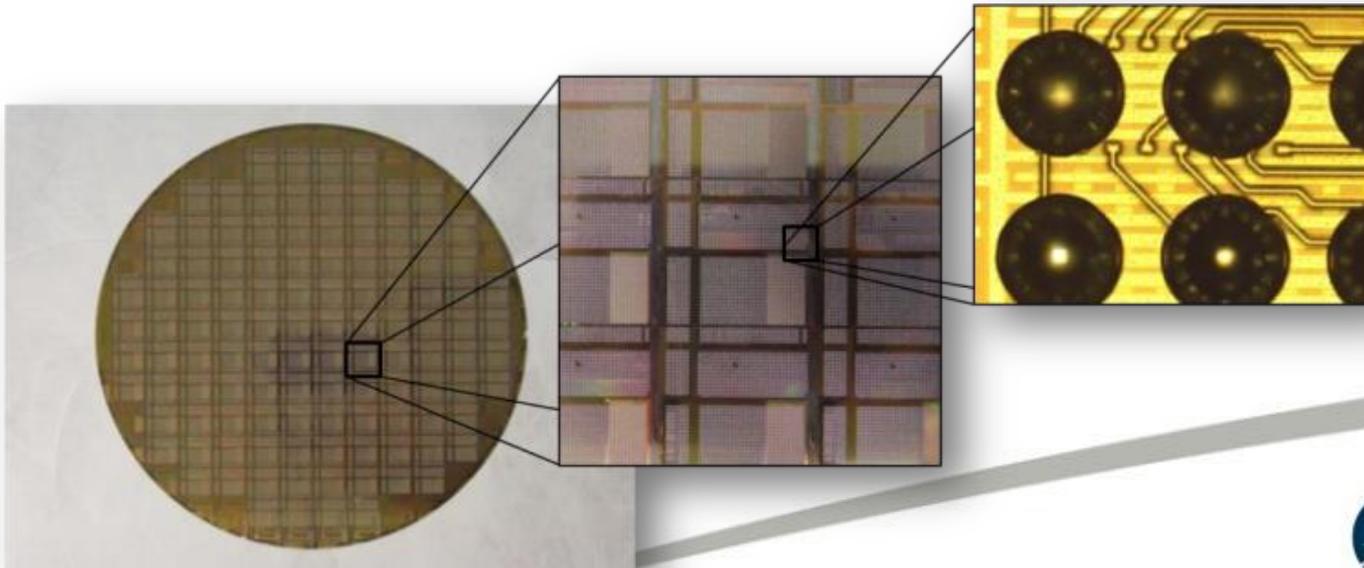
Test image in X-ray set



Installed at I13

# LHC CMS Upgrade

- STFC Technology Department successfully delivered CMS tracker upgrade ASIC with Imperial College
- Wafer level bump bonding
- Ready for 3-D integration phase
- Track triggering features now included



David Willetts announced UK participation in E-ELT

Cerro Armazones



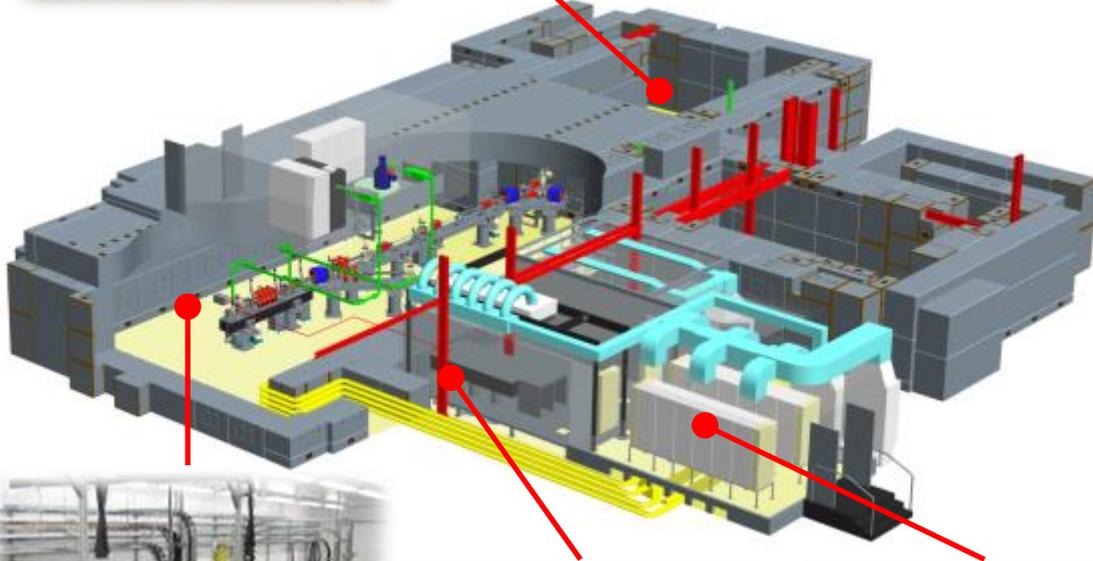


Image credit: ESO

# ALMA Inauguration

# Electron Beam Test Facility - VELA

- £2.5 million funding released by BIS in August 2011
- ASTeC and Technology complete design and intensive procurement during FY 2011/12
- Module assembly and installation now largely complete





# Capital Investment in the December 2012 Autumn statement- spend in 13/14 and 14/15

- Total £600 million to be invested in facilities for technological R & D and Research Council infrastructure.
- Of this £484M has been allocated to the RCs in the following areas;
  - 1. Advanced Materials - £45M** [STFC - £5M for the DIAD beamline at Diamond]
  2. Autonomous robotics - £35M
    - **Big data/ energy efficient computing - £189M** [STFC - £30M, of which £11M for SKA computing and £19M for energy efficient computing]
  - 3. Campuses - £65M** [STFC - £35M, including space cluster building at Harwell]
  4. Energy storage - £30M
  5. Regenerative medicine - £20M
  - 6. State of the art instrumentation - £50M** [STFC - £10.7M allocated to mix of lab equipment, estates and University based equipment in the grant lines, PRD, LHC upgrades and Futures.]
  7. Synthetic biology - £50M

This is in addition to the e-infrastructure capital in 11/12 that funded Dirac , GRIDPP networking , and the Hartree, and the infrastructure funding for the R1 refurbishment at RAL.





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# Spring Budget

HM TREASURY



# Spending Review

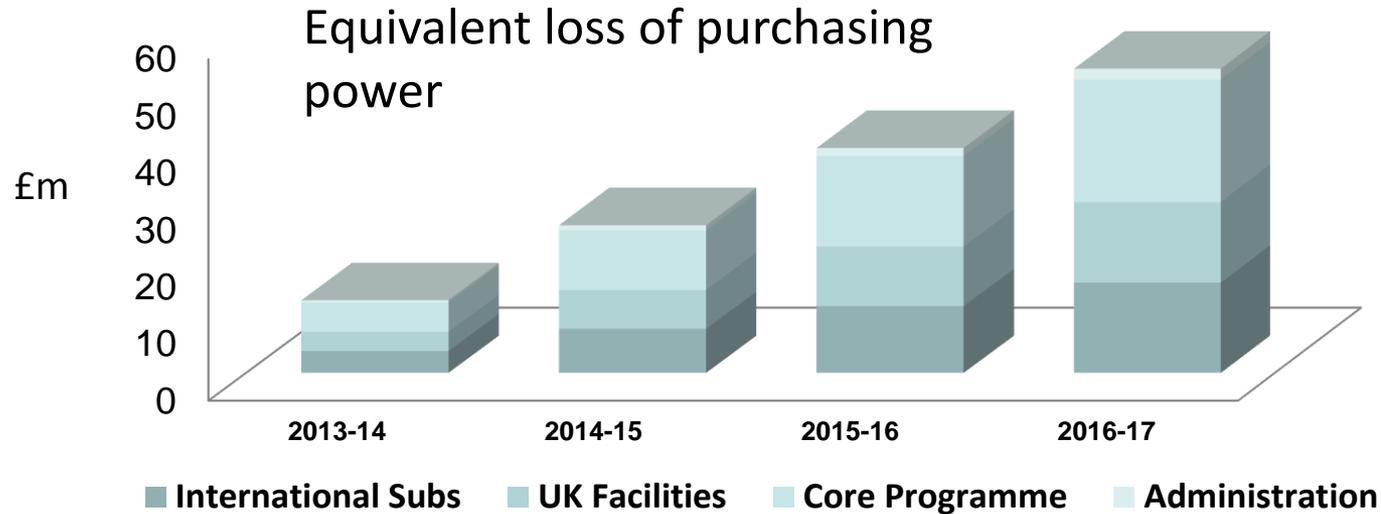
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  - *Planned to include the total Science and Research budget, maybe its high level breakdown (RCUK, HEFCE, Academies), but NOT the allocations to individual Councils.*
- Announcement of the allocations to individual Councils later
  - *May be linked to publication of outcome of the Triennial Review (could be as late as September)*
- BIS working on detailed plan...

# Spending Review

- Stated that 2015/16 budgets for Departments will **continue along their present trajectory** –
  - *This means further cuts to the overall BIS budget*
- Starting point for Science budget is presumably **continued flat cash** but this will put significant pressure on rest of BIS
- STFC already actively canvassing stakeholders and marshalling our evidence base
  - *SCPP, Astronomy forum, University visits, etc.*
- HMT visit



# Flat cash = loss of purchasing power



- Modelled 2 more years flat cash: results are not pretty
  - *Pressure from electricity prices, inflation, new programme (e.g. Diamond beamlines, open access publishing...)*
  - *Take us beyond the “tipping point” from 2010 CSR*
  - *Results have gone to BIS*



# STFC Impact Report 2012

- **26m** number of people reached by TV and radio coverage of announcement of discovery of new Higgs-like particle

- **£3bn** cost of decommissioning and replacing two nuclear power stations, deferred after research at ISIS supported the case for 5-year life extensions

- **8.3%** increase in applications to physics degree courses

- **46.5m** estimated total audience reached by STFC Public Engagement schemes since 2006

- **£25bn** forecast annual revenue generated through successful exploitation of high performance computing

- **£98.7m** amount invested in research grant funding to UK institutions

- **£500-£700m** estimated economic benefit realised by Oxford Instruments and e2v through long-standing of collaboration and engagement with STFC and its university research communities

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# ResearchFish (e-Val) Update

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- Data used for reporting during 2011/12
- Panel review of system/questions – Nov 2011
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- Second data collection – 15 Jan 2012-04 Apr 2013
- Over 17,000 new outputs recorded during data collection

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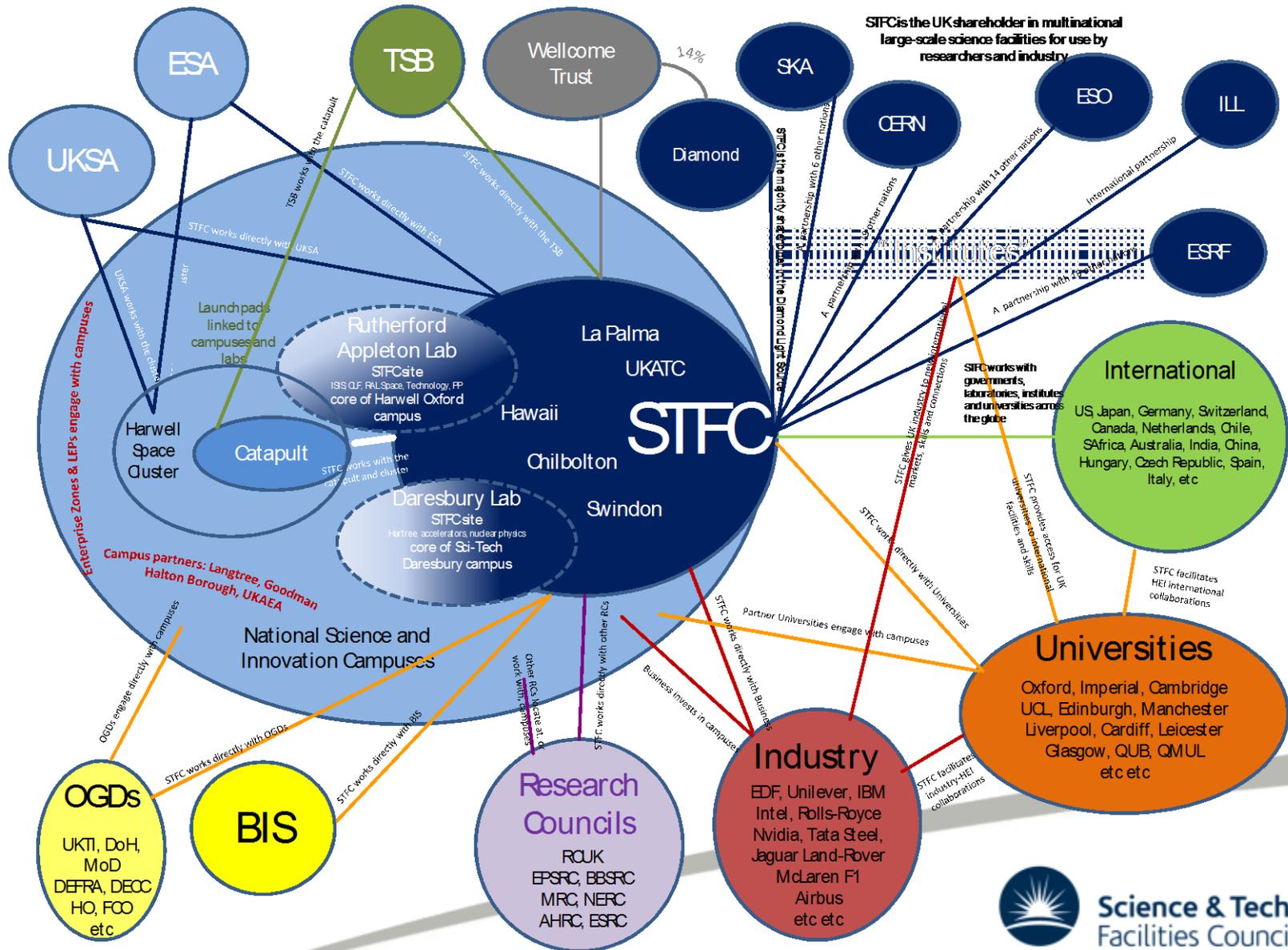


# Triennial Review

- Government announced review on 9 January
  - *STFC set up council subgroup to manage our approach*
  - *Managing RCUK input*
- Triennial Review Group visited RAL and DL, talked to stakeholders
- RCUK submitted evidence to review
  - *STFC submitted a more detailed response as well*
  - *Ongoing interaction with review team*
- Some “interesting” comments from other stakeholders
- Triennial Review phase I report in July...



# STFC's stakeholders





**Stakeholder engagement**



- 2012 was an outstanding year for particle physics
- We have an excellent story to tell
- High level of government support *BUT* challenging economic climate
- Spending review and triennial review underway



What do we need from you?

- Impact examples (e.g. studies for the REF)
- Consistent, national message of broad support for science (*no shooting inwards please*)

**Most of all: we need to sell the excellence and importance of fundamental science**

# DISCUSSION



# IOP Particle Accelerators and Beams Meeting 2013

Professor John Womersley  
Science and Technology Facilities Council

10<sup>th</sup> April 2013



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# Emerging facility priorities

- Programmatic Review is still underway, but we have needed/had the opportunity to input some future capital ideas to BIS
- Based on emerging sense of priorities from Science Board and Advisory Panels



# Emerging priorities for new accelerator-based facilities

- Access to X-ray Free Electron Laser facilities seen as a high priority
  - *Capability of growing importance, currently lacking*
  - *Needs to involve re-engagement with XFEL*
  - *Longer term aspiration to host a UK based XFEL*
  - *Test facilities, CLARA*
  - *Package of light source work could include Diamond lattice upgrade?*



# Emerging priorities for new accelerator-based facilities

- Maintaining access to ISIS (and ILL) with a rolling series of instrumentation, target/moderator and accelerator upgrades is seen as a high priority for neutrons
  - *FETS*
  - *ESS seen as less critical for UK – we have sufficient neutron access through existing facilities – and access to ESS would be lower priority than access to a FEL*



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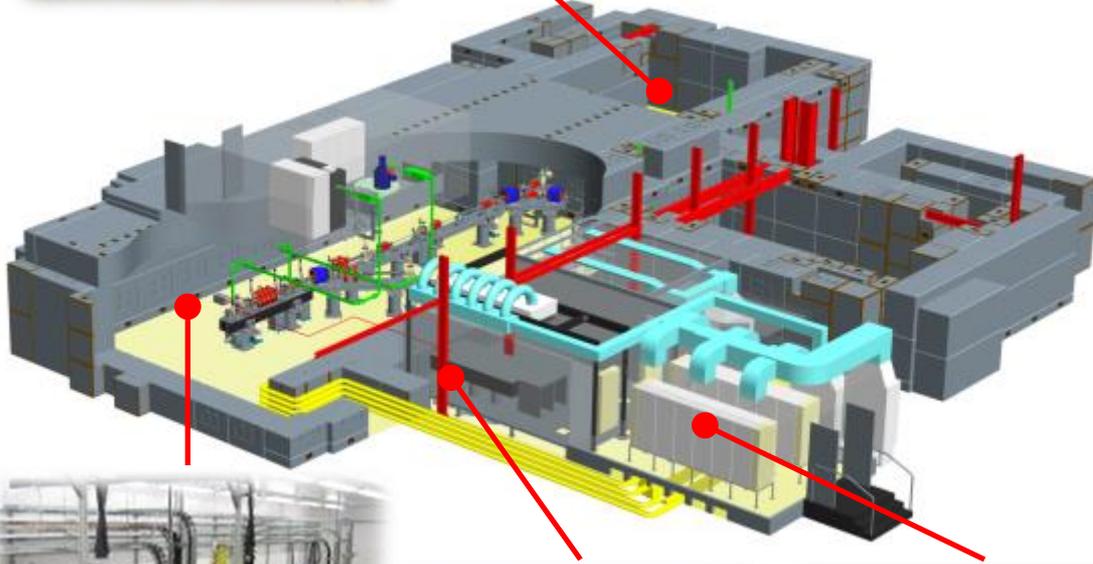
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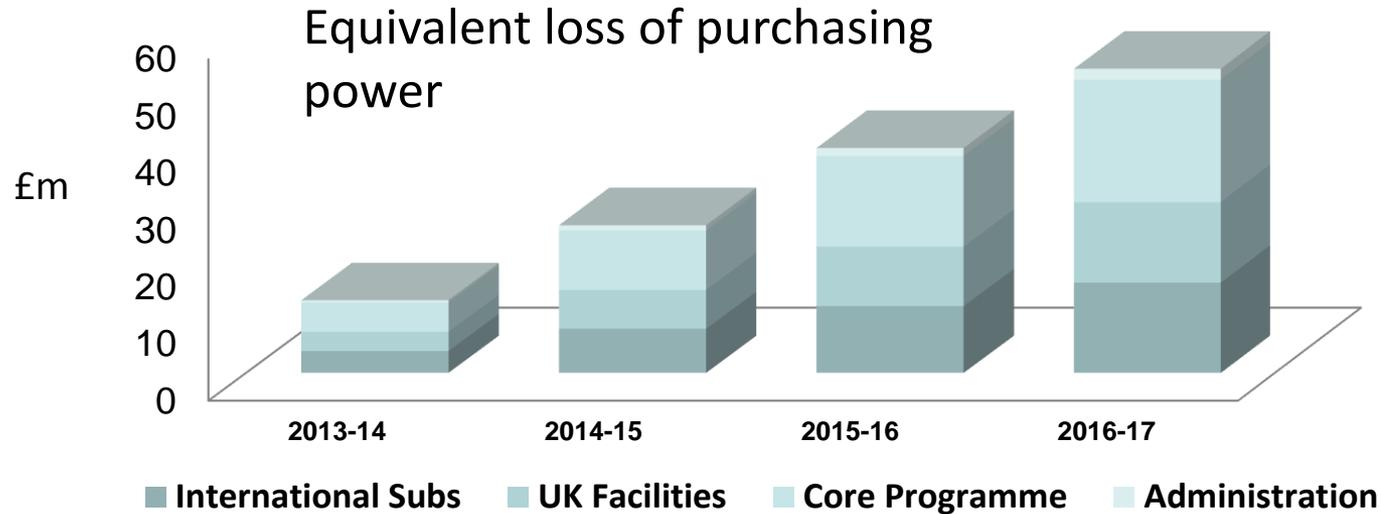
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- Over 17,000 new outputs recorded during data collection

**Thanks to all who contributed!**

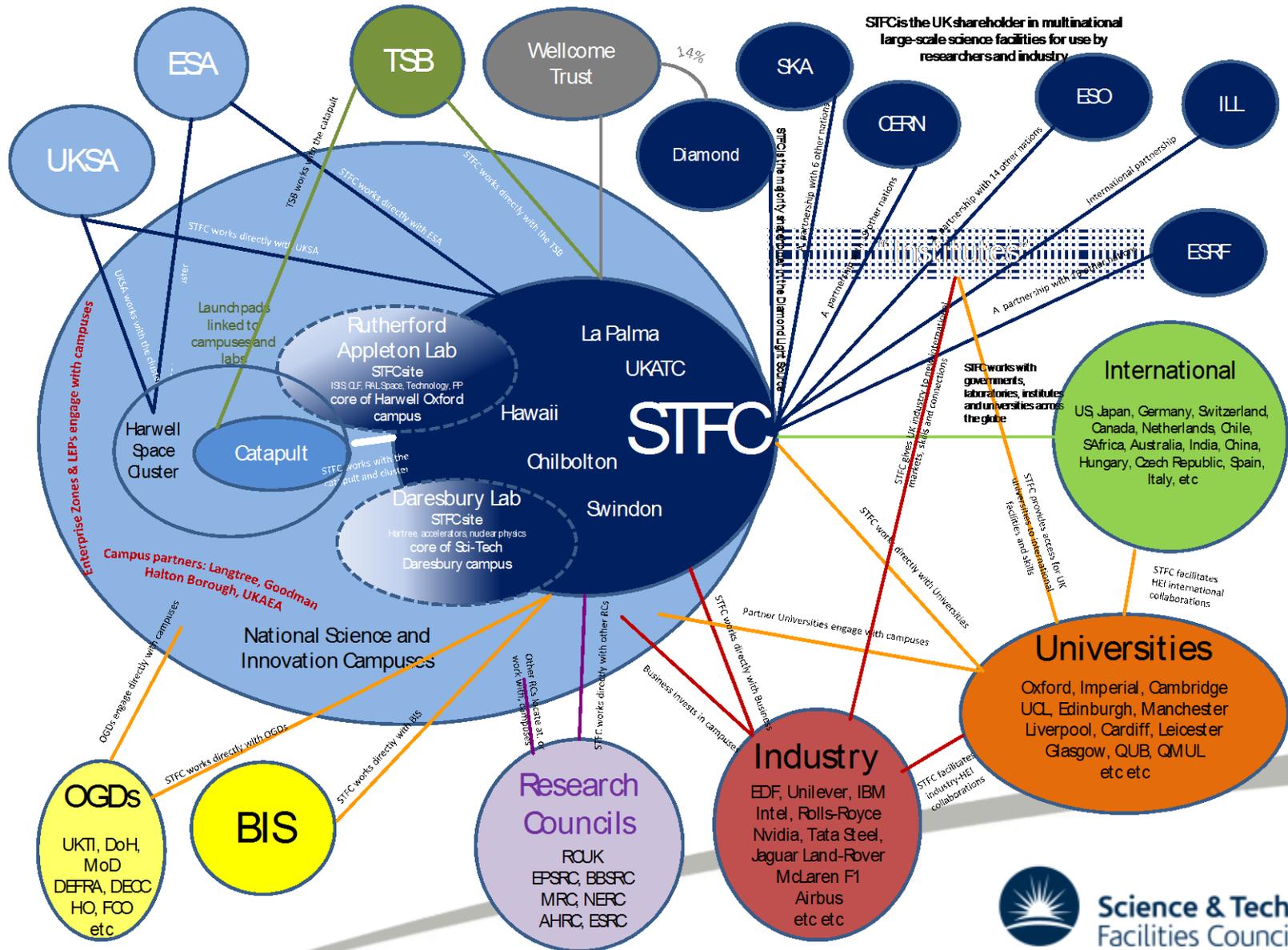


# Triennial Review

- Government announced review on 9 January
  - *STFC set up council subgroup to manage our approach*
  - *Managing RCUK input*
- Triennial Review Group visited RAL and DL, talked to stakeholders
- RCUK submitted evidence to review
  - *STFC submitted a more detailed response as well*
  - *Ongoing interaction with review team*
- Some “interesting” comments from other stakeholders
- Triennial Review phase I report in July...



# STFC's stakeholders





**Stakeholder engagement**



- 2012 was an outstanding year for accelerator-based science
- We have an excellent story to tell
- High level of government support *BUT* challenging economic climate
- Spending review and triennial review underway



What do we need from you?

- Impact examples (e.g. studies for the REF)
- Consistent, national message of broad support for science (*no shooting inwards please*)

**Most of all: we need to sell the excellence and importance of fundamental science**

# DISCUSSION

