



Science & Technology
Facilities Council

STFC's Science and Technology Strategy

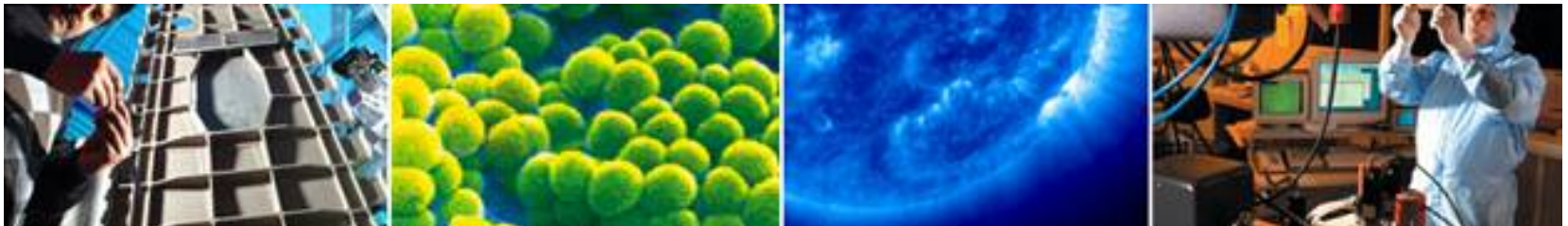
John Womersley
Director, Science Programmes

Nuclear Physics and Particle Physics Town Meetings

April 2008

Addressing the challenges of the twenty-first century

- The twenty-first century is increasingly driven by science and technology.
- It is skills in these areas that will enable the UK to address global scale issues in **environmental change, healthcare, energy and natural resources, and our safety and security.**
- Our stewardship of large facilities and research infrastructures means that we can naturally facilitate novel, interdisciplinary and collaborative approaches to help solve many of these challenges.
- In doing so, we can assure the UK's **economic wellbeing** by increasing the scientifically skilled workforce.





Some examples

- *How can we design better treatments for cancer?*
- *How do cells work?*
- *How do degenerative diseases develop?*
- *How can we help meet mankind's need for abundant clean energy?*
- *How can we create new materials?*
- *How can we detect potential terrorist threats?*
- *Was there ever life on Mars?*
- *How are the chemical elements created?*
- *How do planetary systems evolve?*
- *How do galaxies form?*
- *Why is there a universe, and what is it made of?*

- The science programmes and facilities needed to answer these questions all build on common technological competencies.
- We have world-leading capabilities in (among others)
 - particle accelerators
 - sensors and detectors
 - advanced engineering
 - space technology
 - cutting edge computing, simulation and modelling.
- Our technological capabilities are made possible by a strong theme of collaboration – exploiting the skills base in universities, industry and our laboratories.





Futures

*solutions
for society
and the planet*

Origins

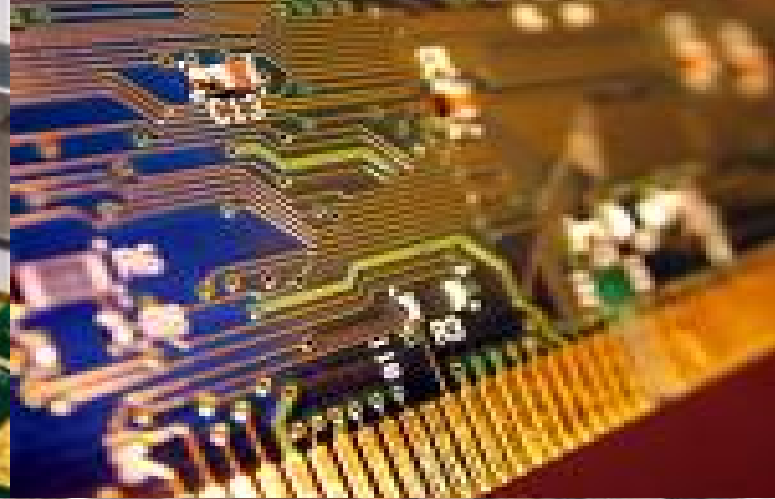
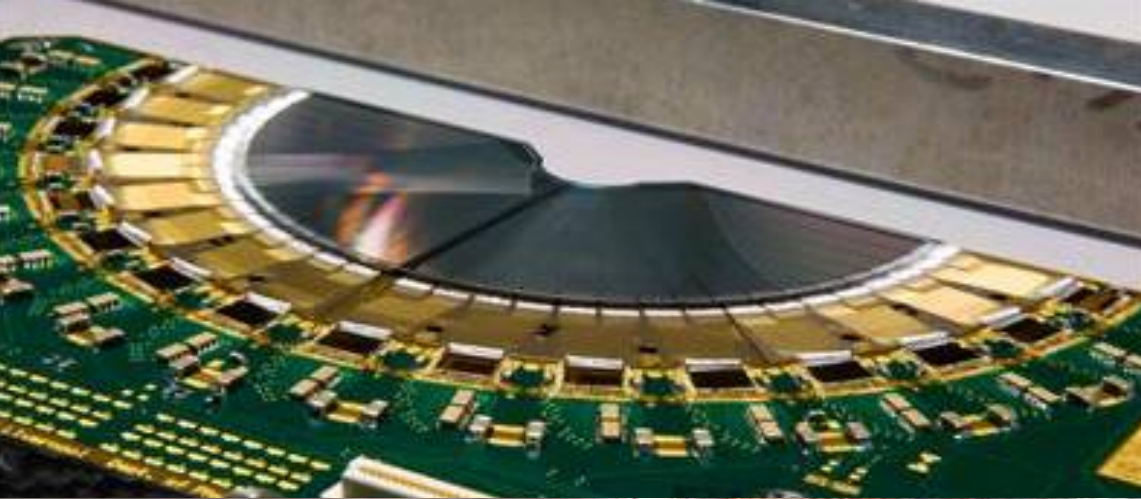
*understanding
our place in the
universe*

Competencies

*technology and
facilities*

Collaboration

*universities, industry,
other nations*

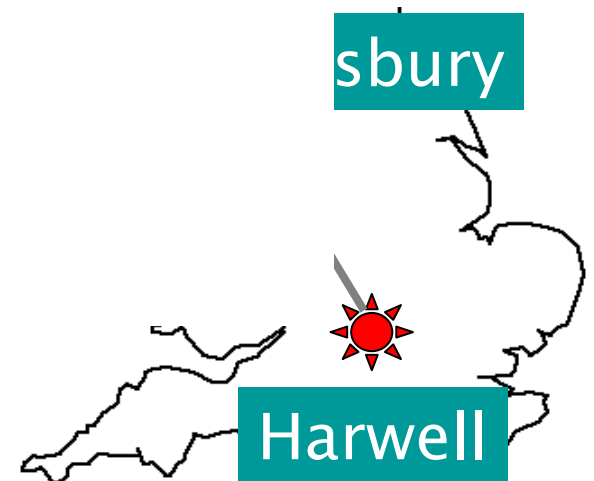


Opening the door
to Science and
Innovation



Science and Innovation Campuses

- The Science and Innovation Campuses at Harwell and Daresbury should become focal points for collaboration and knowledge exchange with industry and academic researchers, and gateways to our in-house expertise and that of the communities we support
- We have identified core technology competencies and we will refocus them on an **outward facing collaborative role** through new Technology Gateway Centres



Gateway Centres

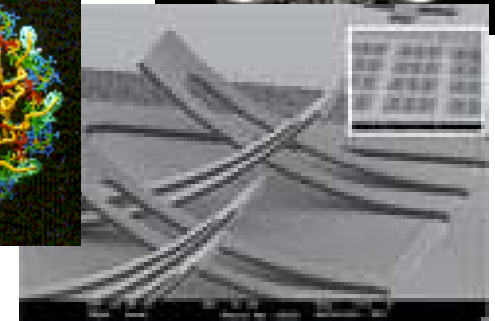
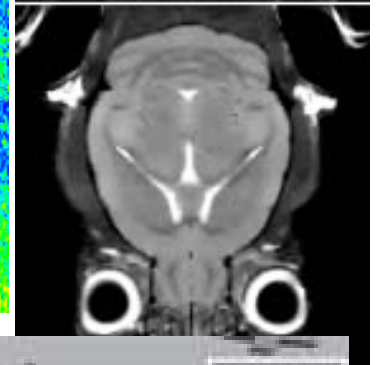
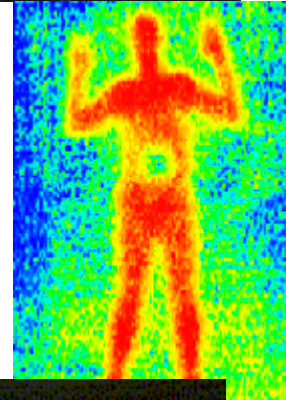
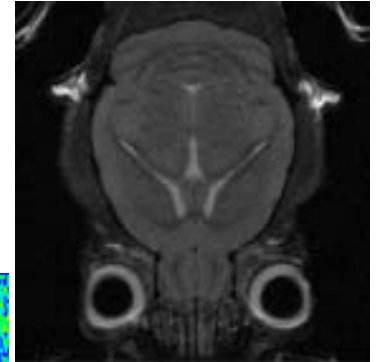
- Based on our core technical competencies
 - **Detector Systems Centre** - advanced detector technology
 - **Space Centre** – a new space centre for the UK
 - **Hartree Centre** – a step-change in modelling capabilities
 - **Imaging Solutions Centre** – transforming “facilities access” into “solutions access”
 - **Joint Institute for Materials Design** – integrating materials innovation with advanced characterization

Futures Programmes

STFC points of contact and networking for:

- Bio-medical
- Security
- Energy
- Environmental Change
- Nano-science and Technology
- Digital economy

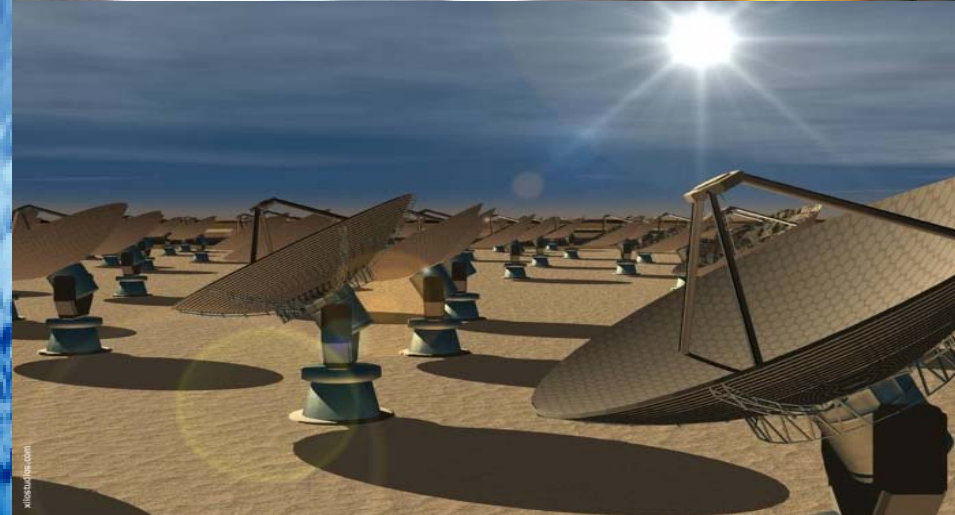
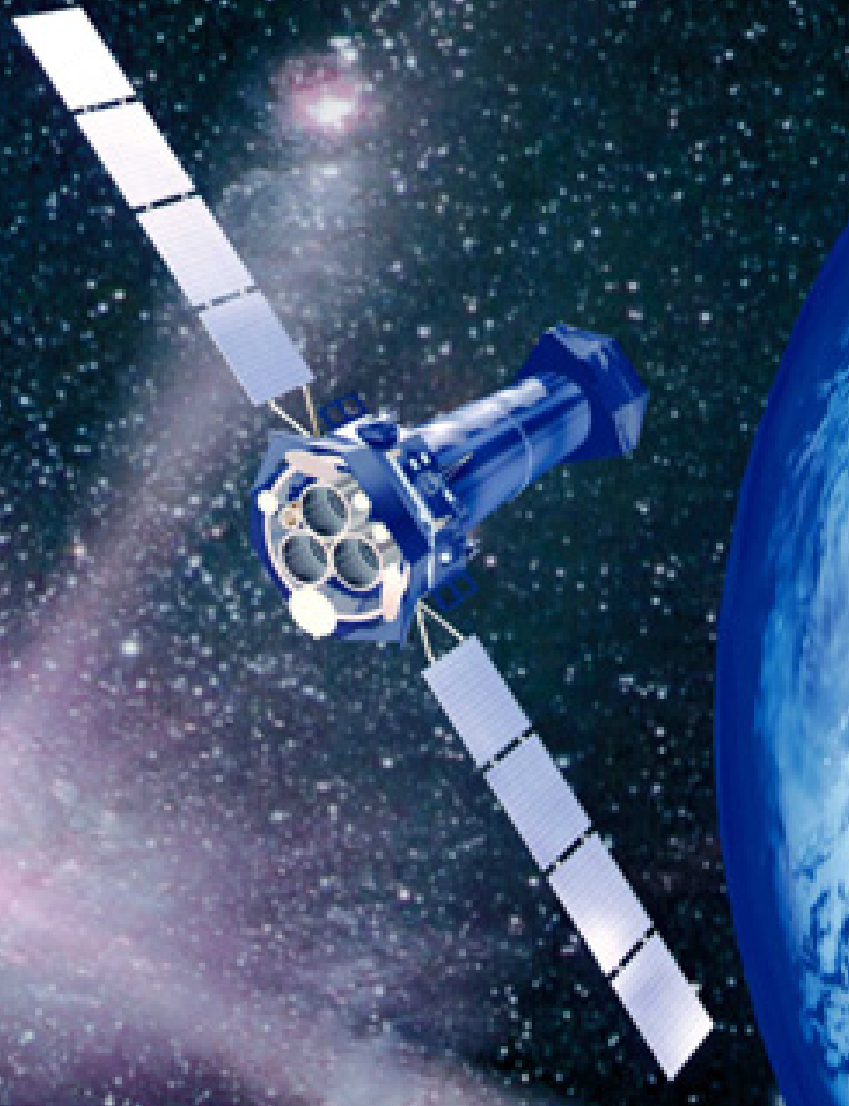
Will be initiating workshops in each area



A scientifically skilled society

- A highly skilled workforce is an essential part of a successful twenty-first century economy
- People are also one of the most powerful vectors of knowledge exchange
- STFC contributes by attracting young people into scientific and technological careers through its challenging science programmes, outfitting them with highly analytical skills desirable in sectors such as finance, IT and high-tech industry
- As a component of the campus initiatives, we aim to develop strategic regional and national partnerships to establish a skills development and capacity building programme

Origins – understanding our place in the universe



Particle Physics

- Particle physics aims to discover the fundamental building blocks of the universe, the laws that govern their interactions, and how these particles and forces have shaped the structure of the cosmos.
- Our highest priority is to exploit the Large Hadron Collider at CERN - its results should transform particle physics.
- Our membership of CERN gives us a strong and central role: one of the two major LHC experiments is UK-led.
- The UK research community has been a major player in constructing the LHC and the highly advanced computing infrastructure to handle the data; we will support its exploitation of the exciting results from the machine





- The recent discovery that neutrinos have mass and mix with each other may ultimately account for the very existence of our universe through matter-antimatter asymmetry arising in the neutrino sector. UK researchers have played an important role in these discoveries.
- There are a range of opportunities for taking this area of science forward, including
 - a programme of accelerator neutrino experiments that started with the MINOS project at Fermilab and now involves a significant role in the T2K experiment in Japan, which is due to come on-line in 2009;
 - R&D towards the SuperNEMO experiment, which will test whether neutrinos and anti-neutrinos are actually the same thing.
- The level of future funding in these areas will be dependent on the outcome of our programmatic review.

Nuclear Physics

- The goals of nuclear physics are to understand why atomic nuclei exist, how the forces that hold them together behave, and how the chemical elements on which life depends were made in stars.
- The first accelerators capable of producing beams of unstable nuclei are now becoming available, which opens an important new window to explore these questions.
- The UK has an active research community despite hosting no accelerator facility. We will focus our investment in nuclear physics on the highest priority programmes at international accelerator facilities to ensure the continued vitality of the UK nuclear physics programme. Notably we will participate in the new Facility for Antiproton and Ion Research (FAIR) at GSI in Germany.

FAIR



- FAIR “start event” on November 7th
- We have committed £10M from NP programme and we bid to LFCF for additional funds (unsuccessfully, alas)
- FAIR GmbH to be set up by middle of 2008

Accelerator Research

- Accelerator technology is a key enabler across a large fraction of our research
 - Particle and nuclear physics
 - Synchrotrons and free electron light sources
 - Neutron sources
- Our decision to develop a New Light Source project and the need to consider how to take forward a programme in neutrino physics all impact on our overall investment in accelerator science and technology.
- I am working with the Cockcroft and John Adams Institutes and ASTeC to focus our activities on a strong set of core competencies with broad relevance to future facilities, and taking steps to retain key ex-ILC effort

Accelerator programme

- I am seeking to support
 - Design study for New Light Source project
 - Operation (at level TBD) of ERLP/ALICE
 - MICE exploitation and Phase II
 - Neutrino Factory
 - High Power Proton Accelerators
 - Some work on novel techniques (FFAG...)
 - Underlying technologies (SCRF...)
 - ASTeC, Cockcroft and Adams Institutes + Rolling Grant effort
 - Retention/redirection of ex-ILC effort
- With some belt tightening, I believe this will be possible

New Light Source Project

- Following the advice of the review, we instituted a new project to deliver a proposal for a New Light Source
 - Project being taken forward within a new Photon Sciences Department in STFC
- Project will be focused on the key science drivers: start by identifying these science drivers and how to address them, together with the community
 - science case being developed in conjunction with a new Research Institute for Photon Science involving our university partners
- Aim for a proposal ready for consideration by late summer 2009



Particle Astrophysics

- Particle astrophysics explores the connections between the fundamental constituents of the universe and its large-scale structure and evolution. The recent discovery that the bulk of the universe is not made of normal matter (like you or me) but dark matter and dark energy has emphasised the science opportunities in this area.
- We are pursuing a number of projects in this area, including
 - direct detection of gravitational waves with GEO600 and Advanced LIGO (and potentially the next generation observatory “Einstein Telescope”);
 - the direct detection of dark matter with Zeplin III, located in the Boulby mine in North Yorkshire;
 - the cosmic microwave background experiment, CLOVER.

Interdisciplinary Research Facilities



Facilities for the Future of Science

- Research Councils' Large Facilities Roadmap is being updated
- Draft 2008 Roadmap is at <http://www.rcuk.ac.uk/research/resinfra/lfroadmap.htm>
- Includes any projects that we may wish to fund through the Large Facilities Capital Fund, and major projects funded through the Council's base level of support, subscriptions etc.
- Consultation period on draft roadmap is now complete and final document is being prepared

STFC projects in the roadmap

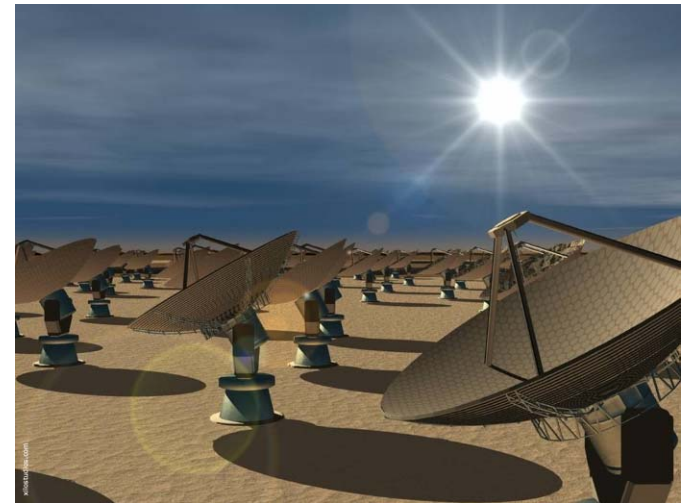
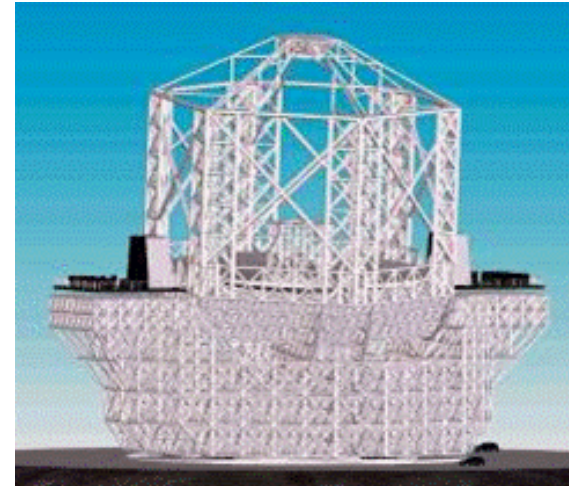
Planned facilities

- The Daresbury and Harwell Science and innovation campuses
- Diamond Beamlines Phase III
- ISIS - Target station 2 instrumentation (Phase III)
- European Synchrotron Radiation Facility (ESRF) upgrade
- The European X-Ray Free Electron Laser (XFEL)



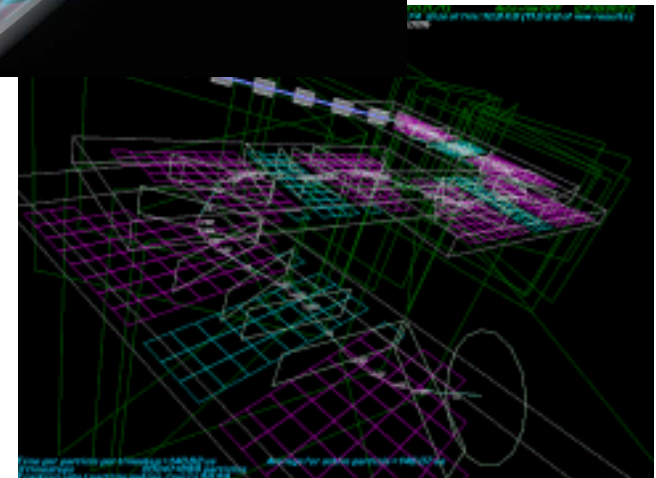
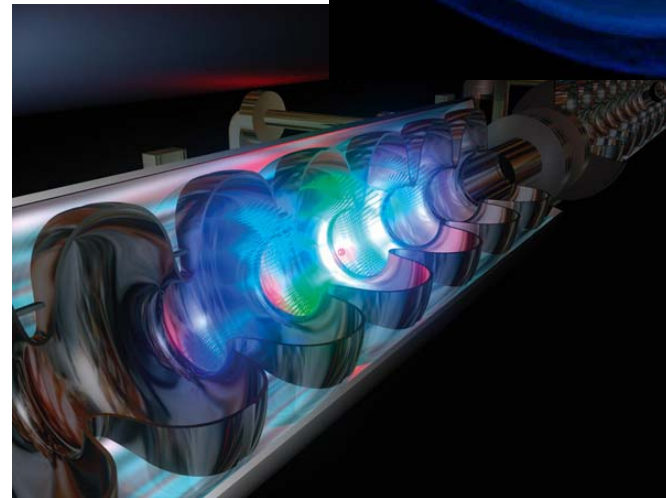
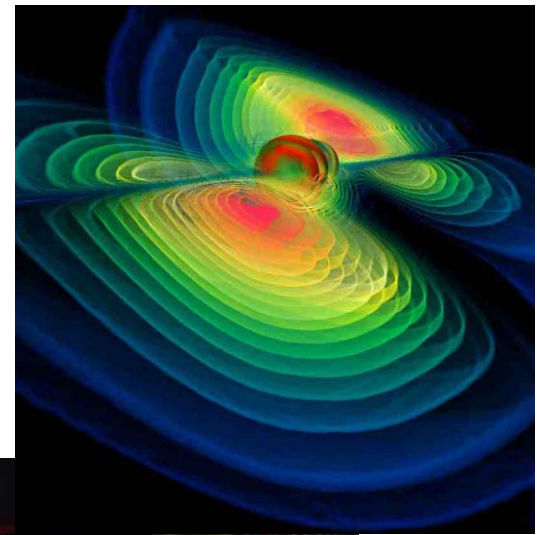
Planned facilities

- Diode Pumped Optical Laser for Experiments (DIPOLE)
- Extreme Light Infrastructure (ELI)
- European Extremely Large Telescope
- Facility for Antiproton and Ion Research (FAIR) at GSI in Darmstadt
- Square kilometre array (SKA)



Emerging Facilities

- New Light Source project
- European 3rd Generation Gravitational Wave Observatory (Einstein Telescope)
- Neutrino Factory
- Future Particle Physics Colliders
- Underground Science Initiatives
- High power laser Energy Research Project (HiPER)
- Next generation neutron sources



Future UK based facilities

- STFC council has expressed its desire to see the UK host at least one major large-scale facility in the longer-term. The most likely candidate facilities from the roadmap list are:
 - New light source – project now underway to develop this concept for a proposal to be considered in 2009
 - A next generation accelerator-driven neutron source – either as a major upgrade to ISIS or as a new machine, with the potential for co-development for particle physics (neutrino factory) and/or nuclear physics applications
 - The HiPER laser-driven fusion project



Evolving the Strategy

Programmatic Review

- Biennial review of STFC's ongoing projects and facilities
- The goal is to inform how the programme should evolve and the Council's investment decisions
- It consisted of an assessment of
 - strategic importance, impact, competitiveness, level of UK involvement, scientific user base, science output, Outreach, Training and Industrial impact
- Carried out by the Science Committees for Particle Physics, Astronomy and Nuclear Physics (PPAN) and for the Physical and Life Sciences (PALS)
- The process was overseen by the Science Board

The review was a significant, challenging task and we thank the committees and everyone involved for their dedication and diligence.

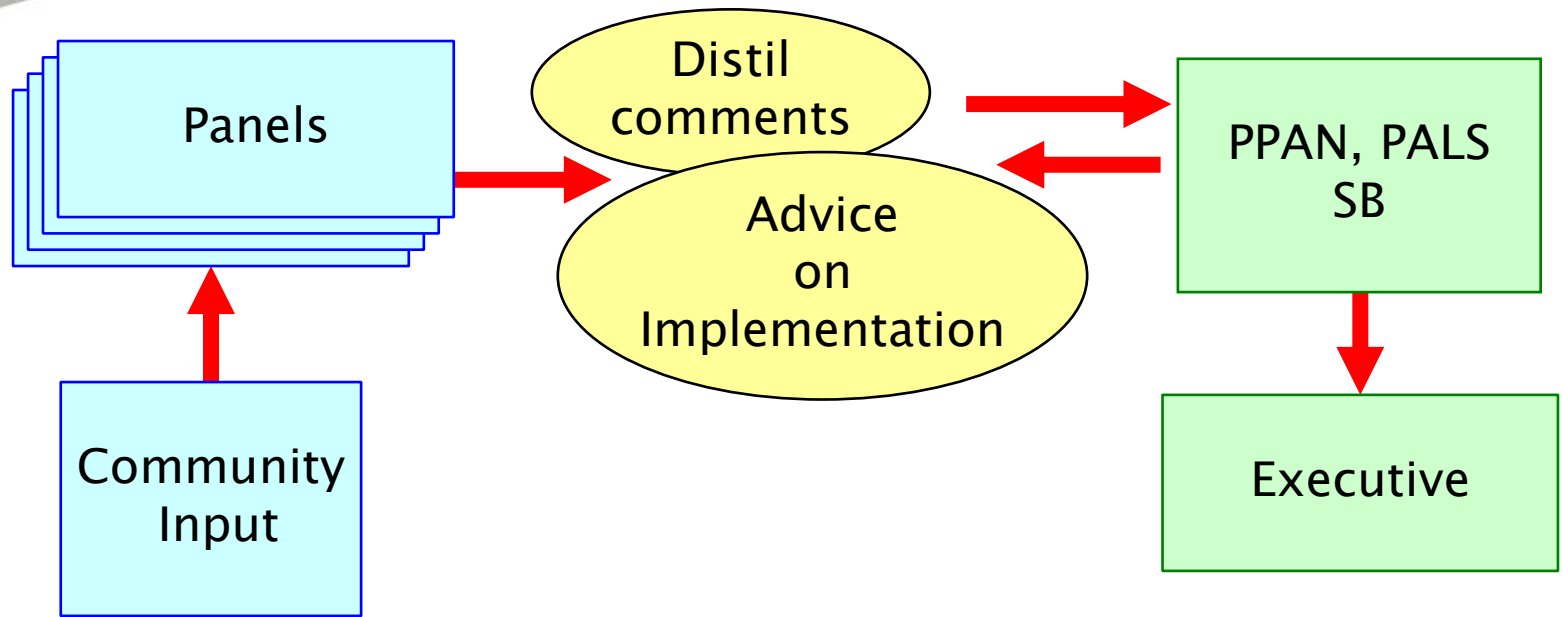
- It is important to emphasise that PPAN and PALS did not identify any poor quality projects in their rankings
- All of the projects and facilities reviewed were doing, or would do, good science, and all were of sufficient quality to be funded
- Inevitably there are more good ideas than we have resources to meet
 - this exercise is essentially about *re-prioritisation*
 - it is the case that we will have to cease to support some projects to ensure that we are investing in the best, including being able to take advantage of new opportunities

Priorities

- Projects were assessed and grouped into categories:
 - High, Medium-high, Medium-lower, Lower
- Those in the lower category are most at risk
- BUT no funding decisions have been made at this time, pending the results of consultation
- In constructing a programme, strategic considerations will also be taken into account. In some cases Council has already identified this to be the case
 - Bepi-Colombo, e-Merlin, Gemini, Solar Physics, UKIRT
- Though they were not part of this review, I would like to reaffirm our commitment to R&D towards HiPER, and participation in XFEL and FAIR

Consultation and Panels

- Over 1400 comments received during consultation
- Comments now fed in to 10 small panels of active researchers in subject areas:
 - particle physics, nuclear physics, astro-particle physics, ground-based astronomy, ground-based solar terrestrial physics, space science and exploration, laser facilities, synchrotrons and free-electron light sources, and neutron facilities.
- The STFC selected the chair for each panel, and these chairs are organising the exercise within each area.
- Update on timescale and panel membership is at www.scitech.ac.uk



- The panels will
 - Distil, review, synthesise the comments received
 - feed back to SB, PPAN, PALS and executive on programme priorities
 - give advice on how best to implement the outcome of the review within the financial envelope available

Per ardua ad astra

- The future is not short of challenges
- If they are to be addressed, we will need to harness
 - science
 - technology
 - innovation
 - and the continued enthusiasm and dedication of people like you
 - even in bad times



Questions, comments?

Your input is welcome:

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