The Science and Technology Facilities Council and its Health and Cancer Care Theme

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STFC Futures Health and Cancer Care Theme Leader
Outline

- The Science and Technology Facilities Council
- The Futures Programme and the Health and Cancer Care Theme
- An STFC Strategy for Cancer – Playing our part
- Examples of STFC capabilities
- STFC funding opportunities
An introduction to myself

- Born and grew up in Ravenna - Italy
- 2003 – 2012: Particle Physics Dept / STFC
- 2010 – present: STFC Futures Programme as cancer lead (up to Summer 2013) first and then healthcare theme leader (from Summer 2013)
- 2009 – present: visiting lectureship at University of Oxford
The Science and Technology Facilities Council
The Science and Technology Facilities Council

STFC is an independent, non-departmental public body of the Department for Business, Innovation and Skills (BIS)
Annual budget ~ £475M

http://www.stfc.ac.uk/

HM Government (& HM Treasury)

BIS Department for Business Innovation & Skills

RESEARCH COUNCILS UK

Arts & Humanities Research Council

Medical Research Council

BBSRC bioscience for the future

NERC Natural Environment Research Council

Economic & Social Research Council

EPSRC Pioneering research and skills

Science & Technology Facilities Council

Computational Radiotherapy Symposium
Cambridge, 17.06.15
UK National Facilities
ISIS, Diamond, Central Laser Facility

Research in nuclear and particle physics and astronomy

International Science Facilities
CERN, ESO, ESRF, ILL

Science and Innovation Campuses

Computational Radiotherapy Symposium
Cambridge, 17.06.15
STFC sites

UK Astronomy Technology Centre
Edinburgh, Scotland

Daresbury Laboratory
Daresbury Science and Innovation Campus
Warrington, Cheshire

Polaris House
Swindon, Wiltshire

Rutherford Appleton Laboratory
Harwell Science and Innovation Campus
Didcot, Oxfordshire

Chilbolton Observatory
Stockbridge, Hampshire

Boulby Underground Science Facility
Boulby mine
Saltburn-by-the-Sea, Cleveland

Joint Astronomy Centre
Hawaii

Isaac Newton Group of Telescopes
La Palma

+ Universities across the UK
The Futures Programme
and
the Health and Cancer Care Theme
The STFC Futures Programme

- Created in January 2009
- Goal: to increase STFC impact in meeting the four global challenges (CSR 2007):
  1. Energy
  2. Environment
  3. Healthcare
  4. Security
- Challenge-led programme
- Creates opportunities = Identify unmet needs + Match them to STFC skills and expertise
The Health and Cancer Care Theme

- **Vision:** “To contribute to the national healthcare effort”
- **Challenge-led theme**
- **Will focus on two of DH priority areas:**
  1. Cancer
  2. Dementia
- **Identifies new opportunities:**
  1. Top-down plus bottom-up approach to identify unmet clinical needs
  2. Match of unmet clinical needs with STFC capabilities
An STFC Strategy for Cancer
Playing our part
The road to the cancer strategy

- First steps:
  1. Engaged with the cancer community
  2. Worked with the STFC community

- Developing the strategy:
  1. Brought communities together
  2. Developed strategic framework

- An STFC Strategy for Cancer – playing our part released on 26.03.15
An STFC Strategy for Cancer

Playing our part

- Released on 26.03.15
- Focuses on three key areas with unmet clinical needs
- Developed in consultation with:
  1. STFC community:
     - STFC staff
     - STFC funded university groups
  2. Cancer community:
     - DH and NHS
     - The National Cancer Research Institute
     - Professional bodies: BIR, BNMS, IPEM, SCoR
     - Cancer Research UK
     - Healthcare professionals in hospitals and GPs
The strategic framework

Our vision for cancer
To contribute to the national effort of curing more cancers and saving more lives

Our objectives
- Diagnosis
- Radiotherapy
- Long-term patient follow-up

Our approach
- Focus our technologies and capabilities
- Develop partnerships
- Develop our delivery mechanisms
- Engage with industry
- Prepare for the clinical needs of the future
## Our objectives

<table>
<thead>
<tr>
<th>STFC Technology Area</th>
<th>Cancer area</th>
<th>Hardware</th>
<th>Software</th>
<th>Hardware &amp; Software</th>
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</thead>
<tbody>
<tr>
<td><strong>Diagnosis</strong></td>
<td>Accelerator technology for radioisotopes</td>
<td>Detectors for GP surgeries and imaging</td>
<td>Data collection and analysis for personalised screening, GPs and imaging</td>
<td>Modelling for personalised screening and modelling of detectors</td>
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<tr>
<td><strong>Radiotherapy</strong></td>
<td>Accelerator technology for proton beam radiotherapy</td>
<td>Detectors for beam control systems, QA, in-vivo dosimetry and imaging</td>
<td>Software for radiotherapy, organ motion management and imaging</td>
<td>Modelling of treatment rooms, background, shielding, detectors, etc.</td>
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<tr>
<td><strong>Long-term patient follow-up</strong></td>
<td>Detectors for GP surgeries and imaging</td>
<td>Software to record late side-effects and follow-up information</td>
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Examples of STFC capabilities relevant to healthcare
### A (non exhaustive) list

<table>
<thead>
<tr>
<th>Design and Build</th>
<th>Engineering Field</th>
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<tbody>
<tr>
<td>Detector</td>
<td>Mechanical Engineering</td>
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<tr>
<td>Space</td>
<td>Electrical and Electronic Engineering</td>
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<tr>
<td>Accelerator</td>
<td>High Performance Computing</td>
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<tr>
<td>Clean Technology</td>
<td>Modelling and Simulation</td>
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Some examples

- UK national facilities
- Research programme:
  1. Detectors and sensors
  2. Computing
  3. Accelerators
UK national facilities
UK national facilities

- **At RAL:**
  1. ISIS: Spallation Neutron Source
  2. Central Laser Facility (CLF)
  3. Molecular Spectroscopy Facility
  4. Space Test Facility

- **Diamond:** synchrotron light source. At the Harwell Campus. Co-funded by STFC and Wellcome Trust
ISIS

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A case study from ISIS

Toward the targeted delivery of anti-cancer drugs

Constructed hydrogel / microgel from bio-compatible polymers

In future, injectable hydrogel balls could deliver anti-cancer drugs to target mutant cells

After G Paradossi, E Chiessi, M Telling and E Mobley
CLF: Laser for Science
CLF: Laser for Science

Development of mobile laser systems for application in RCaH, HSIC, and beyond

Multidisciplinary Team
Physicists, biologists, chemists, mathematicians, astronomers

ULTRA
Ultrafast pump-probe linear and non-linear spectroscopies

OCTOPUS
Multi-modal, interlinked laser imaging stations

Support laboratories

Courtesy D Clarke

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A case study from LfS

3D Localization Microscopy
3D “super-resolution” image of breast cancer cells. Green and red spots show location of HER2 and HER3 receptors.

After D Clarke
Research programme: Detectors and sensors
Which is which?

CMS (CERN) ECAL module

PET scanner (courtesy M Partridge)

From the Higgs

To medical imaging
Detector and sensor technologies

- Germanium detectors for imaging
- Scintillating materials and photon detectors for imaging
- CCD technologies for imaging
- CMOS detectors for imaging
- CZT detectors for imaging and spectrometry
- Pixel Silicon detectors for spectrometry
- Raman spectroscopy for cancer diagnosis
- Silicon detectors for beam monitoring

........
Three examples from...

Nuclear physics: Ge detectors

Particle physics: fast scintillators + SiPMs

Space: scintillators + CCD
Research programme: Computing
Computing

➢ Software expertise:
  1. Monte Carlo simulations (GEANT4, etc.)
  2. Detector and system modelling (GEANT4, GATE, etc.)
  3. Computational science (chemistry, biology, etc.)

➢ Large scale High Performance Computing facilities:
  1. Hartree Centre
A (non exhaustive) list of global challenge projects

- Computational radiotherapy @ Cambridge: AccelRT, IRIS, GHOST2
- Pharmaceutical design
- Computational biology
- Next generation weather and climate modelling
- Radiation damage in materials for the nuclear industry
- High energy density plasmas and nuclear fusion
- Whole device modelling of fuel cells
- Investigation of techniques for detection of contraband
Development of an alternative method to calculate scatter correction based on GATE Monte Carlo simulations for targeted radionuclide therapy

An example: simulations for dose determination and imaging

- University of Manchester (nuclear physics group) + Christie Hospital

S/N increased x5.5

S/N increased x6.0

S/N increased x6.0

Courtesy A Robinson and D Cullen

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Research programme: Accelerators
Accelerator expertise

- Accelerator Science and Technology Centre (ASTeC) at DL
- Cockcroft Institute in the North and John Adams Institute in the South
Accelerator technologies

- Development of alternative solutions for radioisotope production:
  1. Lasers
  2. Accelerators (cyclotrons)

- Development of new cheap and compact accelerators for radiotherapy:
  1. Non-scaling FFAGs for proton / ion radiotherapy
  2. Laser driven accelerators for proton / ion radiotherapy
  3. Laser driven accelerators for x-ray radiotherapy
Production of $^{99\text{m}}\text{Tc}$ with lasers

Vulcan Petawatt beamline

Courtesy R Clarke
Production of $^{99m}\text{Tc}$ with lasers

Courtesy R Clarke
Production of $^{99m}$Tc with lasers

Clear 140 keV $^{99m}$Tc emission observed from the $^{100}$Mo (p,2n) $^{99m}$Tc reaction

Activity 8.25 kBq
STFC funding opportunities
STFC funding opportunities

- Global Challenge Programme
- STFC grants for knowledge exchange
- Industrial CASE studentships
  [www.stfc.ac.uk/funding/studentships/industrial-case-studentships/](www.stfc.ac.uk/funding/studentships/industrial-case-studentships/)
- Co-sponsored:
  1. Knowledge Transfer Partnerships
     [www.stfc.ac.uk/funding/working-with-industry/knowledge-transfer-partnership/](www.stfc.ac.uk/funding/working-with-industry/knowledge-transfer-partnership/)
  2. RSE/STFC Enterprise Fellowships
     [www.stfc.ac.uk/funding/fellowships/rsestfc-enterprise-fellowships/](www.stfc.ac.uk/funding/fellowships/rsestfc-enterprise-fellowships/)

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Global Challenge Programme

- To use STFC’s capabilities to develop innovative solutions to global challenges: Energy, Environment, Healthcare and Security

- Funding schemes:
  1. Global Challenge Exploration Awards
  2. Global Challenge Concepts
  3. Global Challenge Partnerships

www.stfc.ac.uk/1833.aspx
Knowledge exchange grants

- Follow-on-Funding: To establish commercial feasibility on scientific and technical merit [www.stfc.ac.uk/followonfunding](http://www.stfc.ac.uk/followonfunding)

- Innovations Partnership Schemes (IPS)
  1. Full and Mini: To transfer technology and expertise to the marketplace in partnership with industry [www.stfc.ac.uk/ips](http://www.stfc.ac.uk/ips)
  2. IPS Fellowships: To support a Knowledge Exchange role to exploit STFC-funded technologies [www.stfc.ac.uk/ipsfellowships](http://www.stfc.ac.uk/ipsfellowships)

- Challenge Led Applied Systems Programme (CLASP): To apply STFC’s research to global challenges [www.stfc.ac.uk/clasp](http://www.stfc.ac.uk/clasp)

- Impact Acceleration Account: To enable Technology Transfer Offices to support commercialisation of STFC science [www.stfc.ac.uk/IAA](http://www.stfc.ac.uk/IAA)
Summary

- STFC provides world-class advanced technologies in the areas of detectors and sensors, accelerators and computing.
- The STFC Futures Health and Cancer Care Theme looks at how STFC capabilities can contribute to the national healthcare effort.
- An STFC Strategy for Cancer Playing our part, published on 26.03, sets directions for STFC to contribute to curing more cancers and saving more lives.
- STFC funding to support application of our capabilities to global challenges, including healthcare, are also available.