

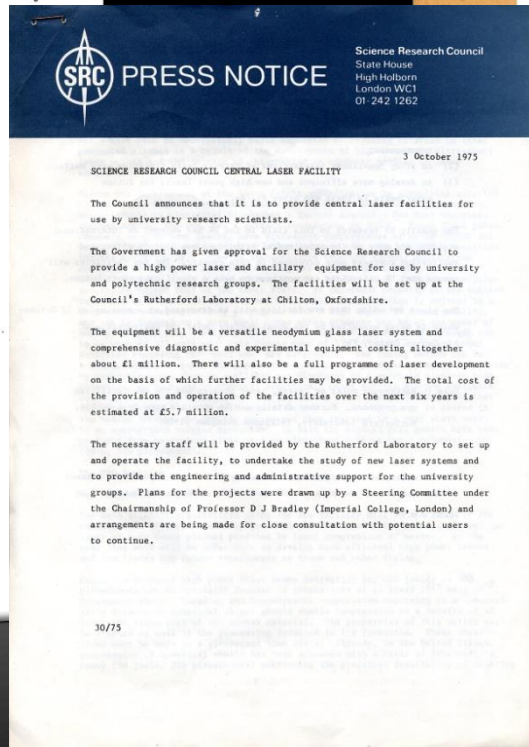
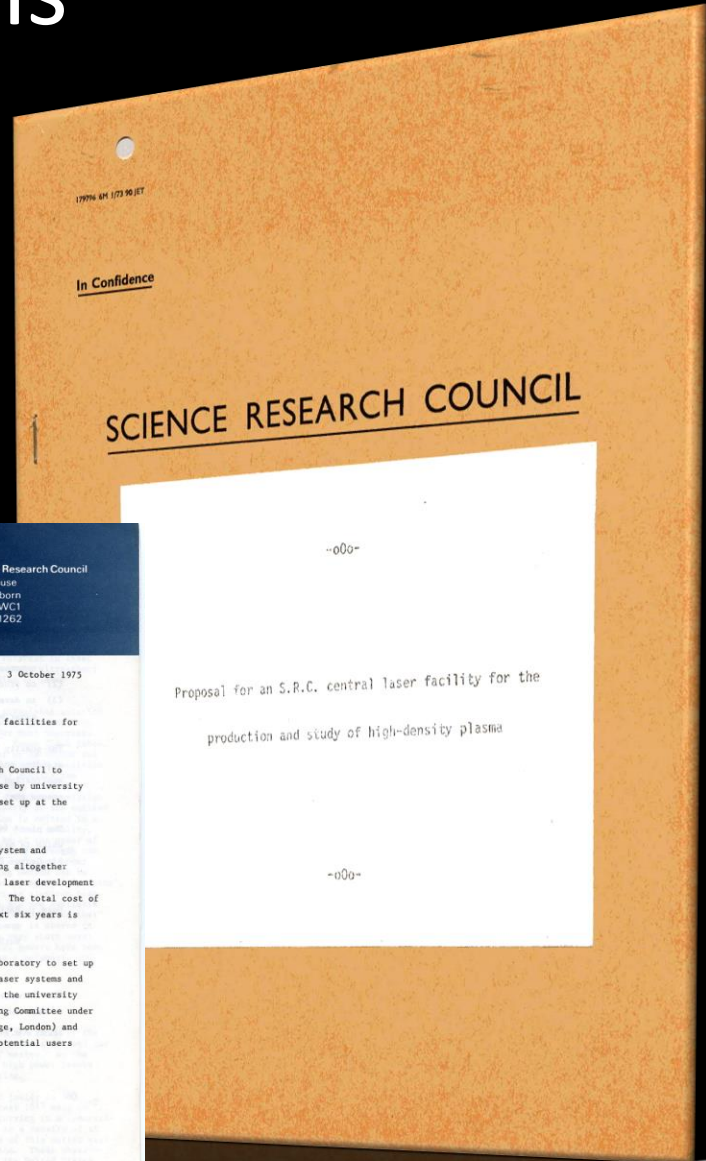
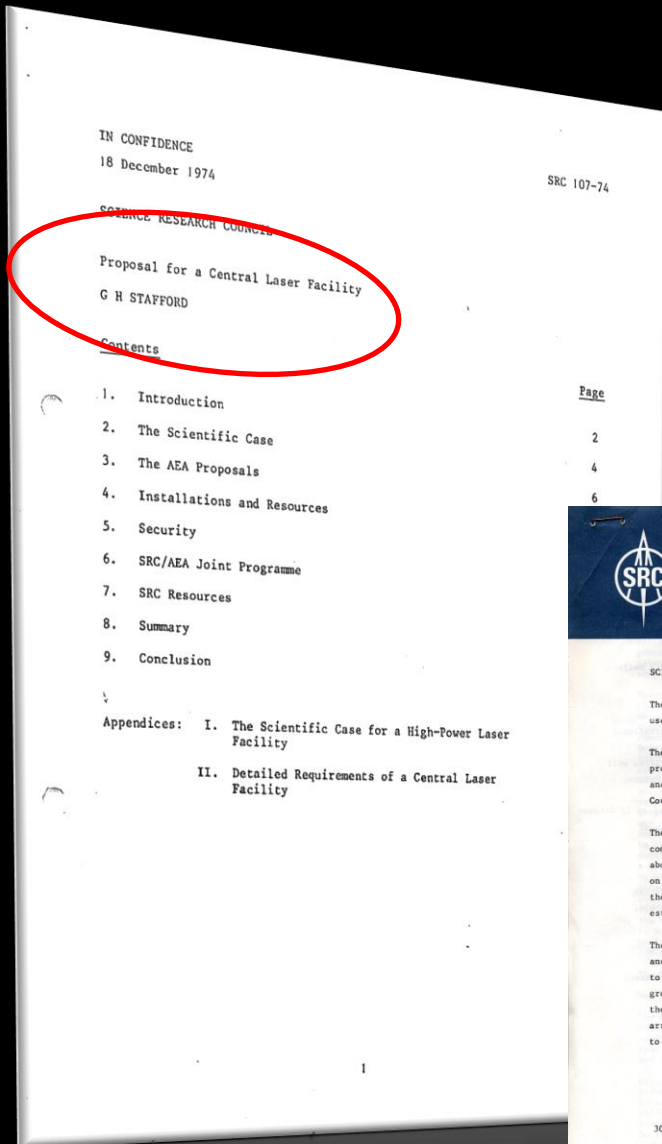
Godfrey Stafford Celebration

The Central Laser Facility

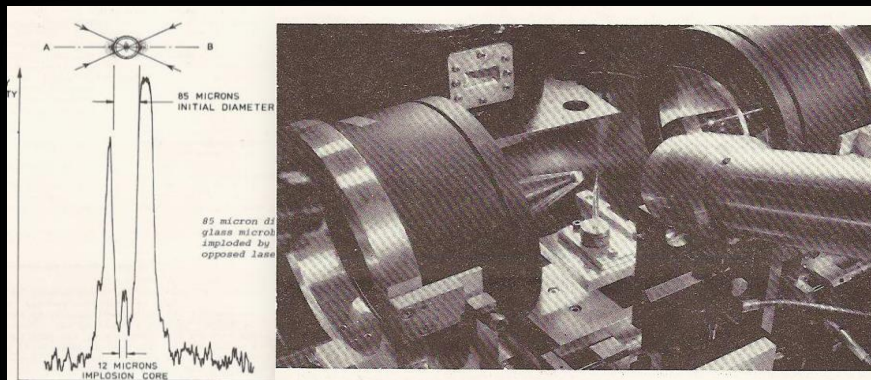
Prof John Collier
Director



Origins



Vulcan Laser Facility (1977)



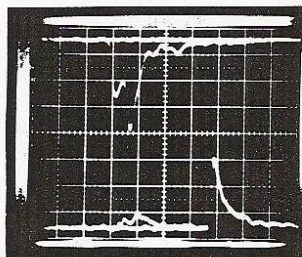
Leading academic
Prof. Dan Bradley

Rutherford Lab Director
Godfrey Stafford

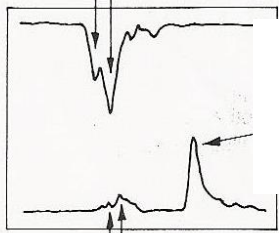


1st Head of
CLF
Prof. Alan
Gibson

SRC Chairman
Sir Sam Edwards



X-RAY — NEUTRON



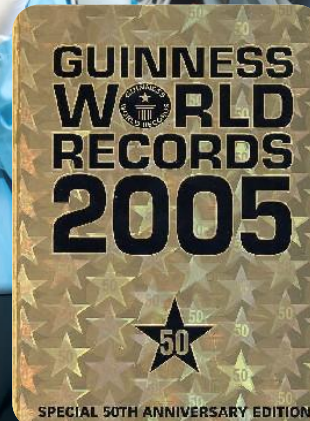
X-RAY — NEUTRON

Neutrons:
September 1977
(10^5 from DT
microballoon)

Vulcan – Today – 37 years on....

WORLD MOST
POWERFUL
LASER FACILITY

Can generate
an optical pulse
with a power of
1 PW (10,000x
Natl. Grid) and
intensity of
 10^{21} W/cm²

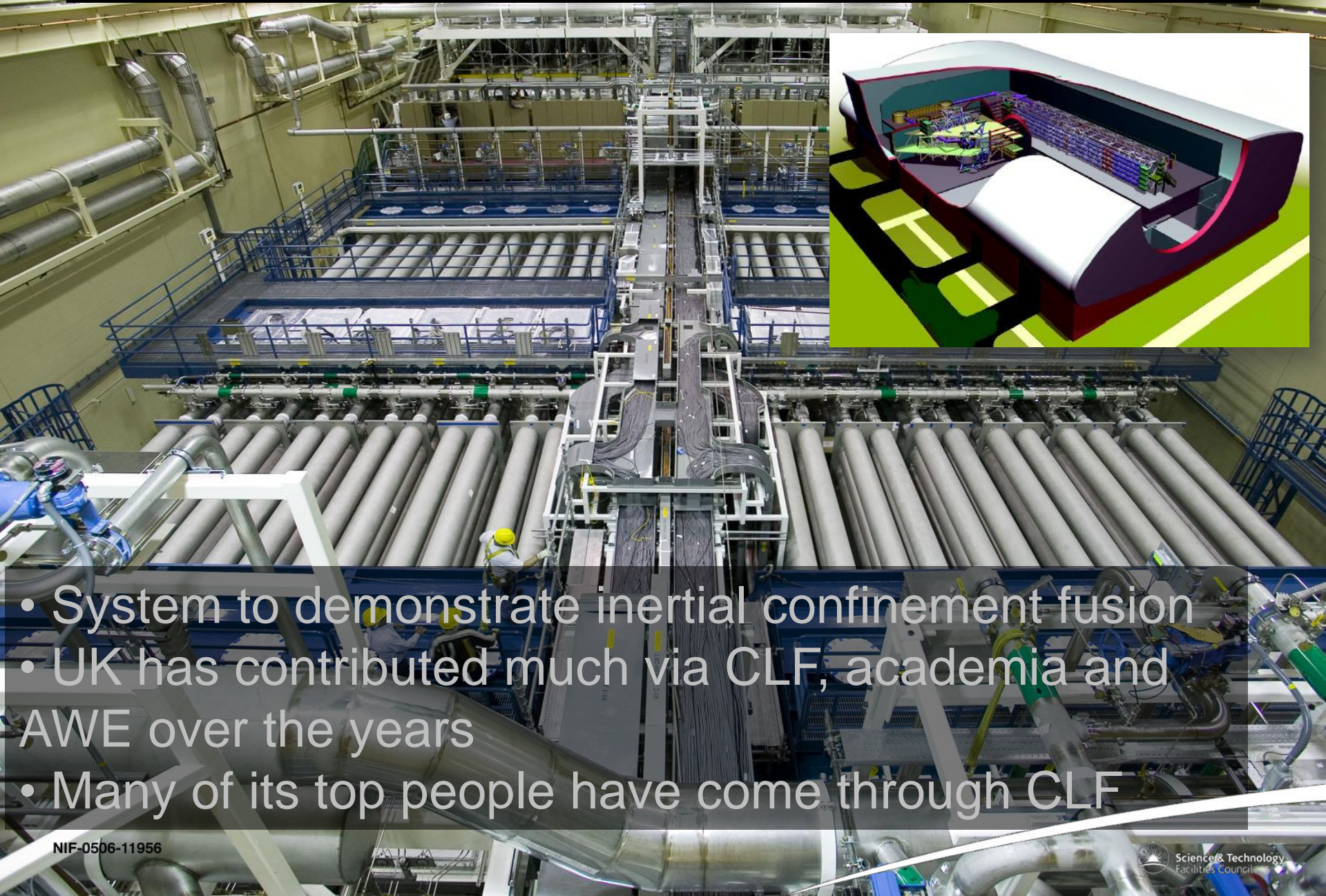


Why the interest...?



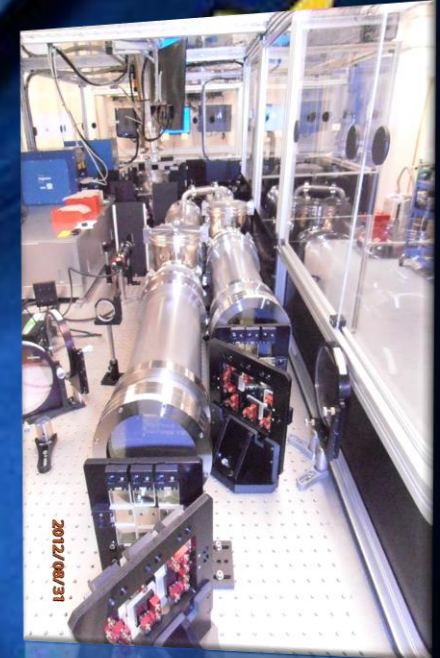
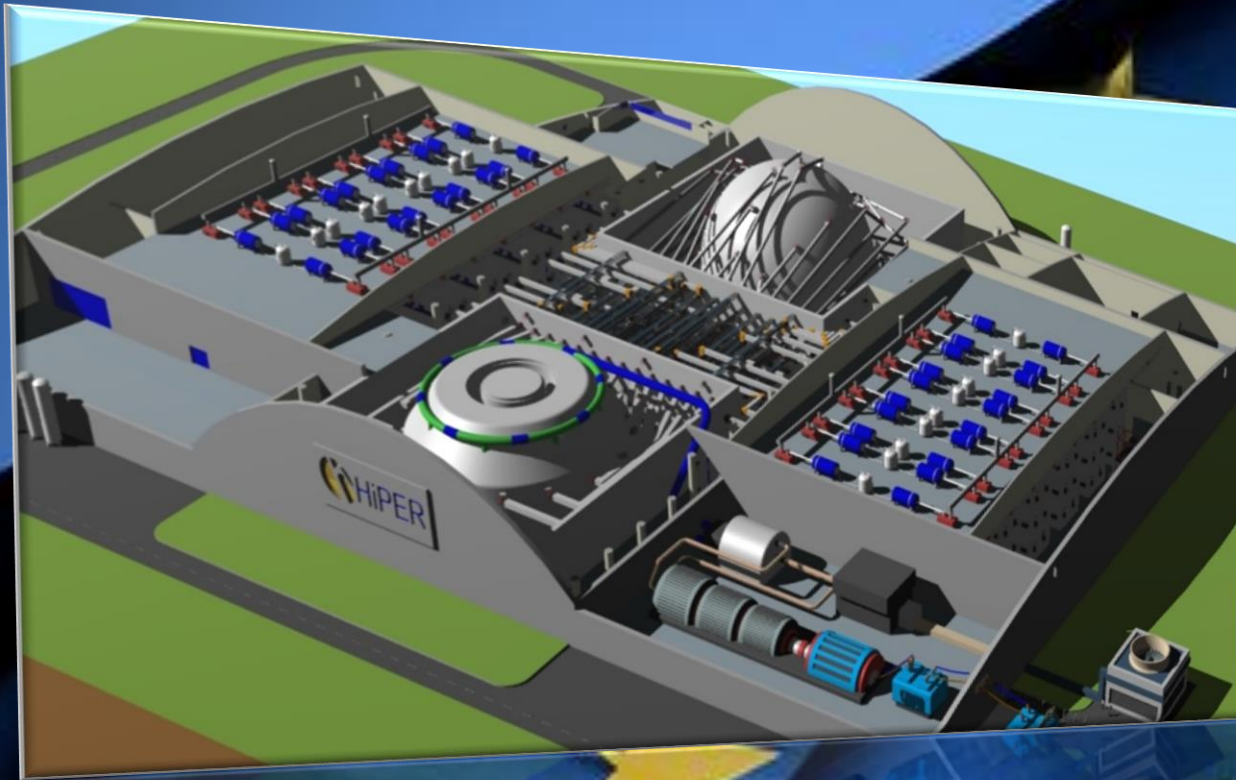
- Vulcan can recreate the conditions of many astrophysical objects
- Squeeze matter together at exceptionally high pressures to extraordinary density e.g. Jupiter, Earth
- Heat matter to temperatures of the sun
- Drive fusion reactions

USA National Ignition Facility



- System to demonstrate inertial confinement fusion
- UK has contributed much via CLF, academia and AWE over the years
- Many of its top people have come through CLF

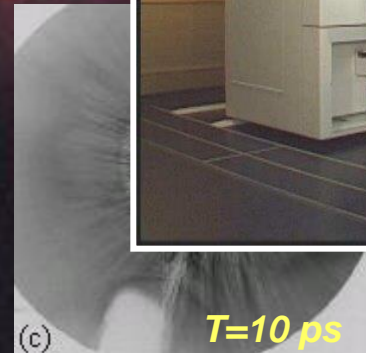
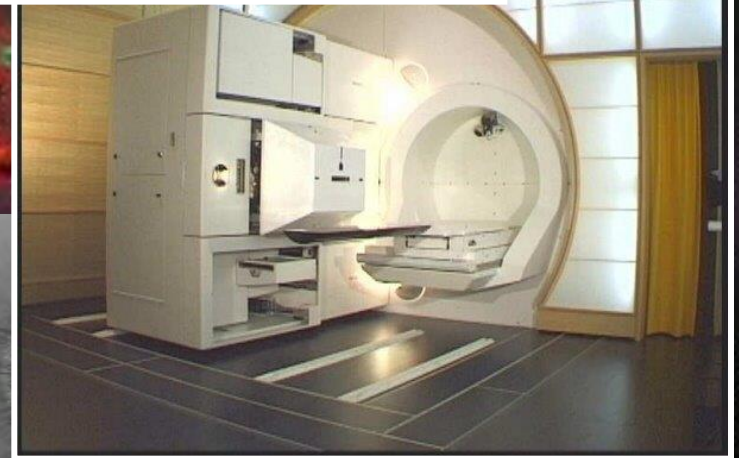
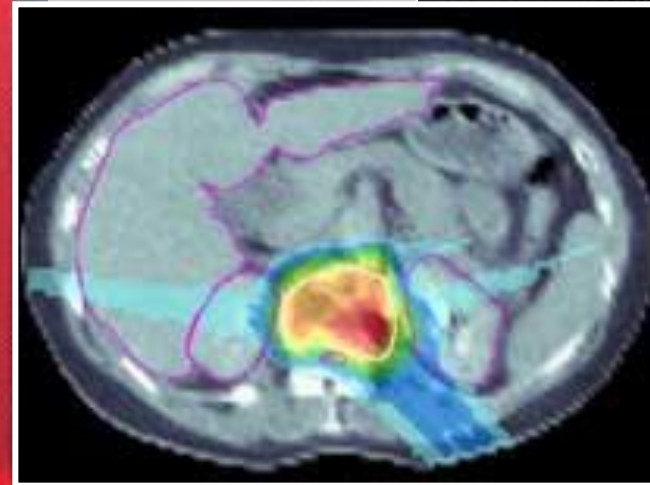
Inertial Fusion Energy - HiPER



- CLF is leading the European HiPER Project
- Promoting the establishment of a European wide programme of R&D for laser driven Inertial Fusion Energy

Relativistic Interactions

- Extreme intensities drive relativistic processes
- E.G. Ions can be driven forwards to very high energy
- ~ 100 MeV in $1\ \mu\text{m}$
- Plasma imaging, oncology ?



EPSRC

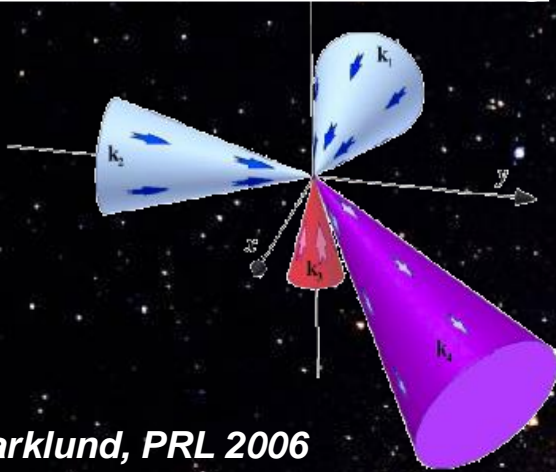
Engineering and Physical Sciences
Research Council



Queen's University
Belfast

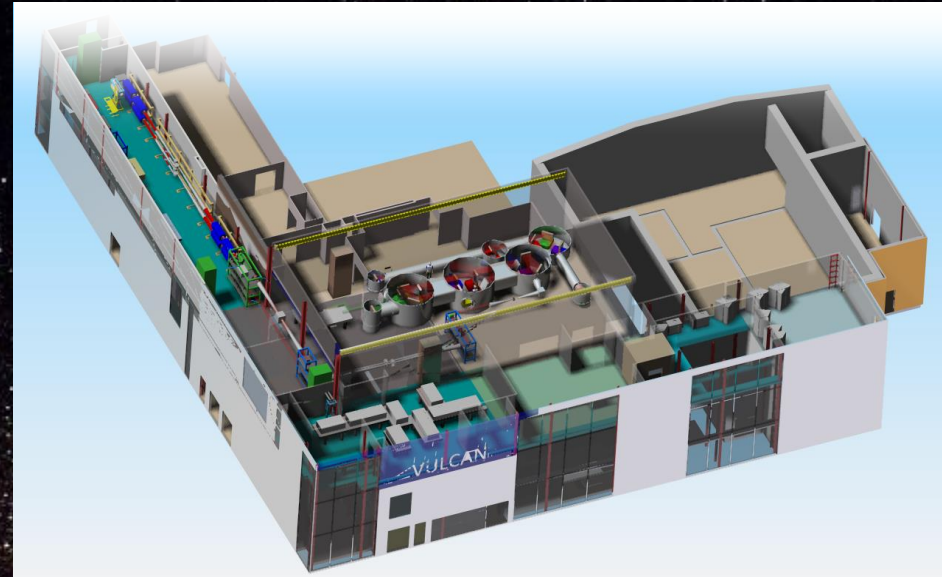
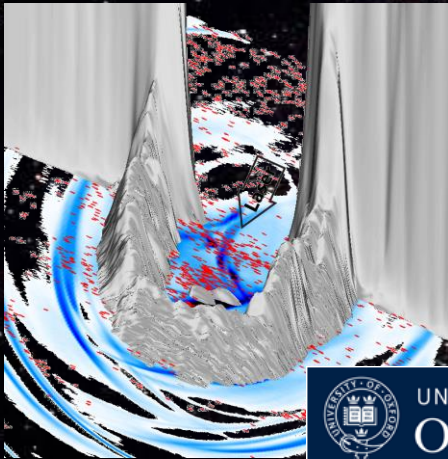
Future - Vulcan 20 PW

Vacuum 4 Wave mixing



Marklund, PRL 2006

'Micro-laboratory' for $e^+/e^-/\gamma$ plasma



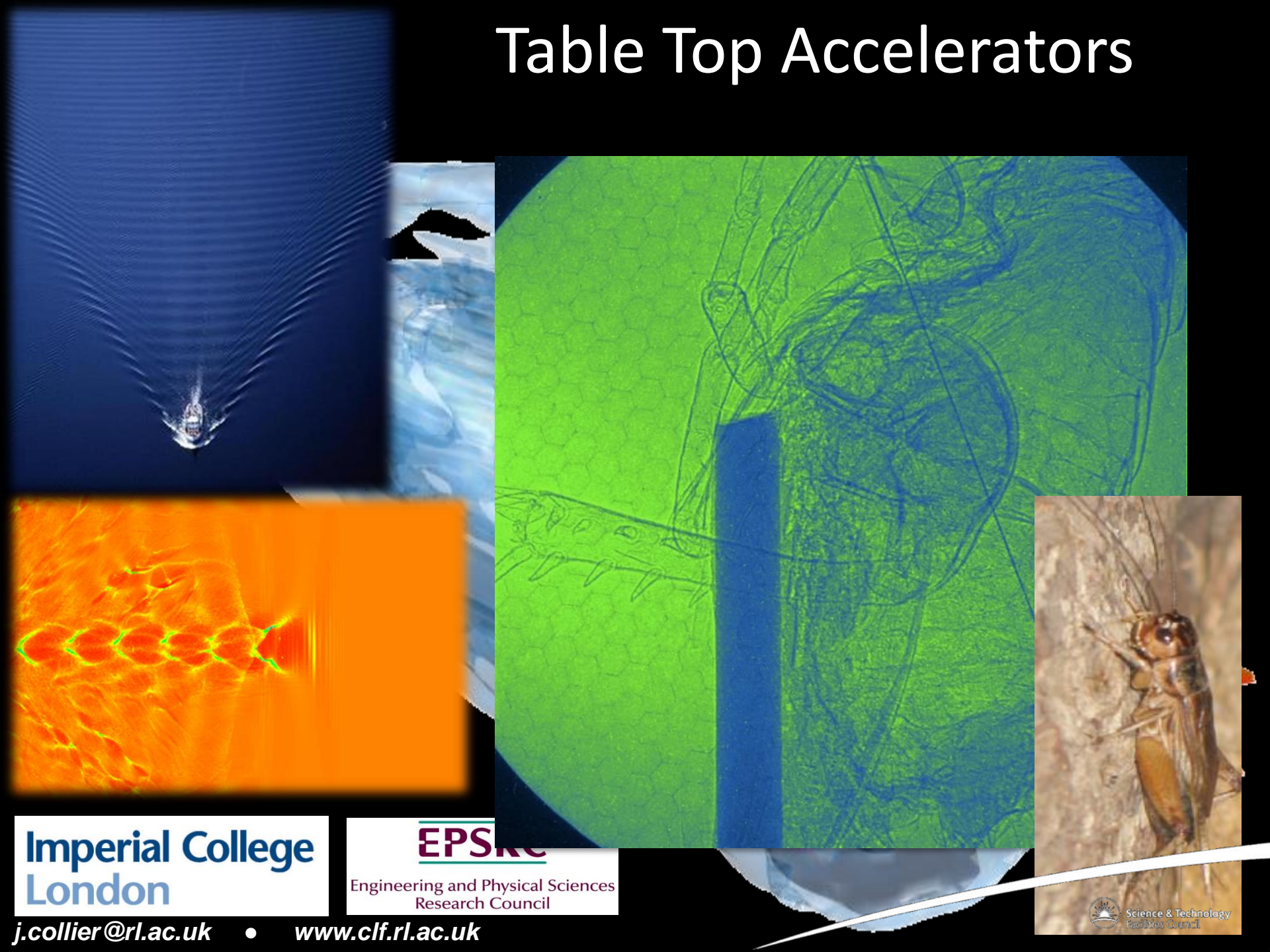
- Next generation of Vulcan will be so powerful as to measurably perturb the vacuum
- “QED” research was mentioned in the original case
- Enable IFE development

CLF's Gemini Facility – New Applications

- Vulcan success spawned other facilities
- Today we have the Gemini Facility
- Worlds first dual beam PW facility
- Worlds first high repetition rate PW



Table Top Accelerators



Imperial College
London

j.collier@rl.ac.uk

• www.clf.rl.ac.uk

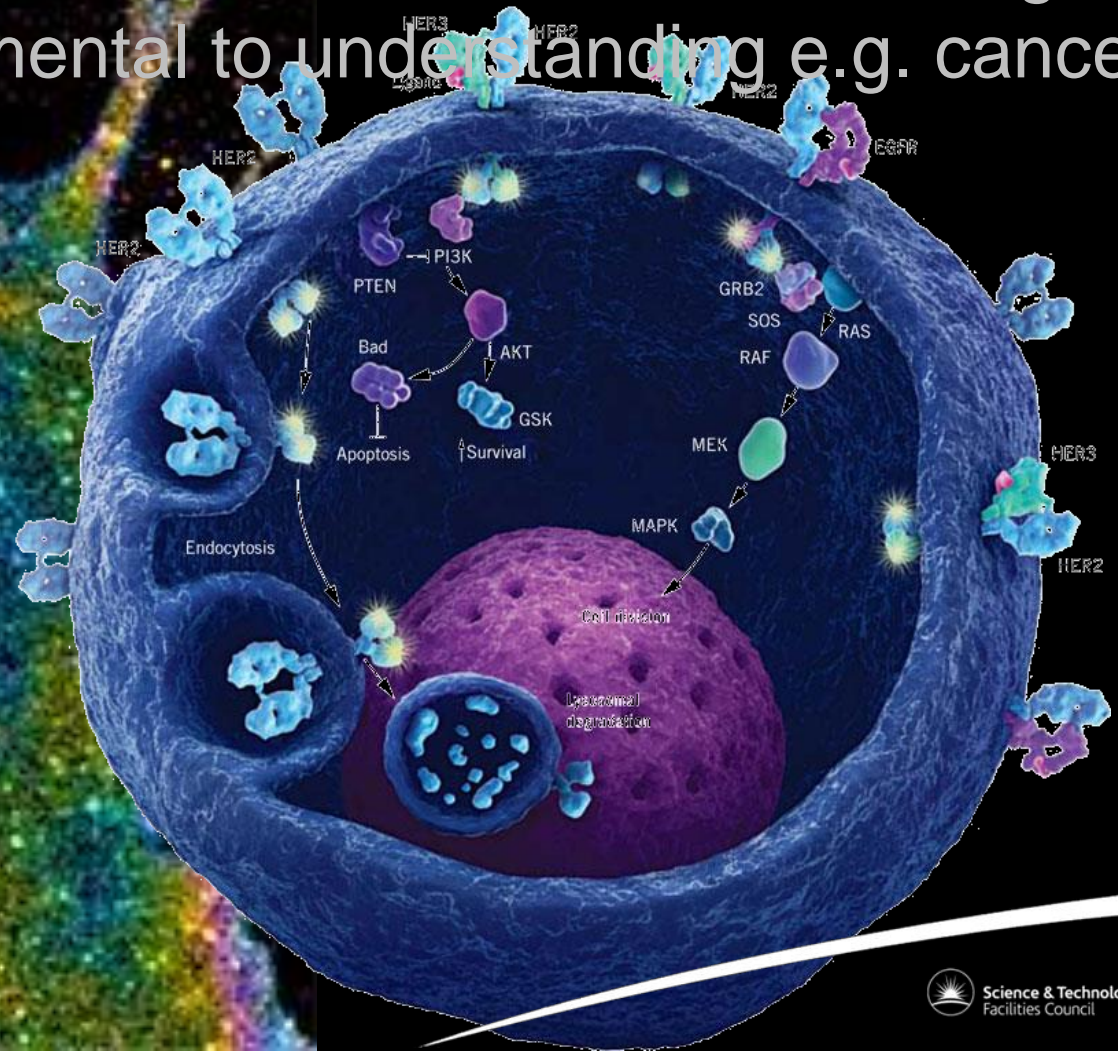
EPSRC

Engineering and Physical Sciences
Research Council

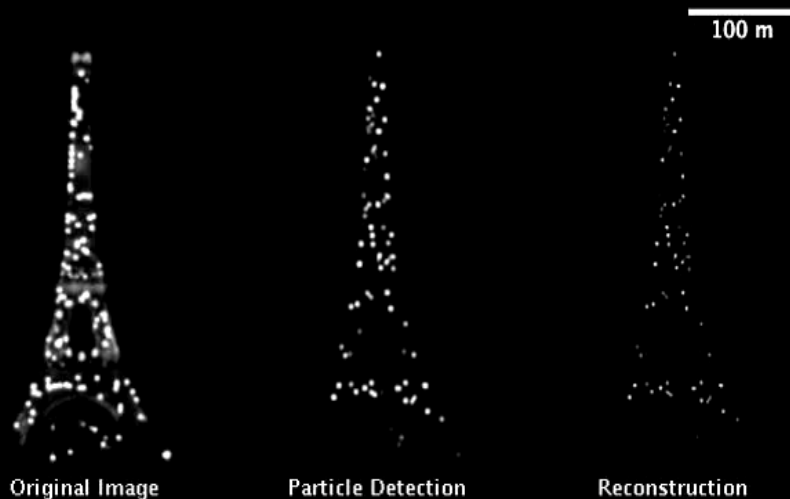
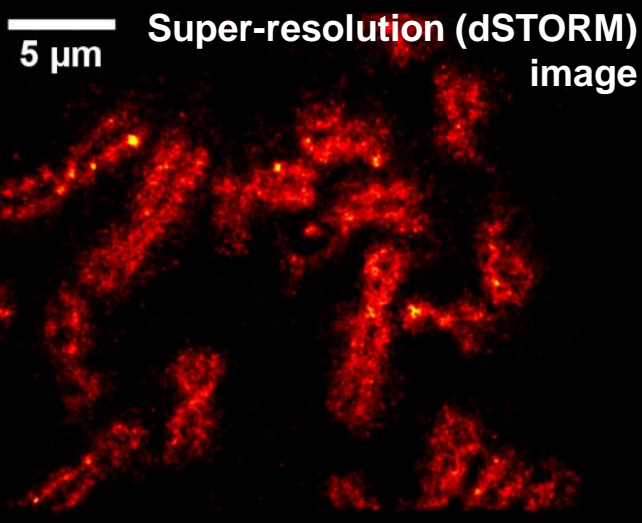
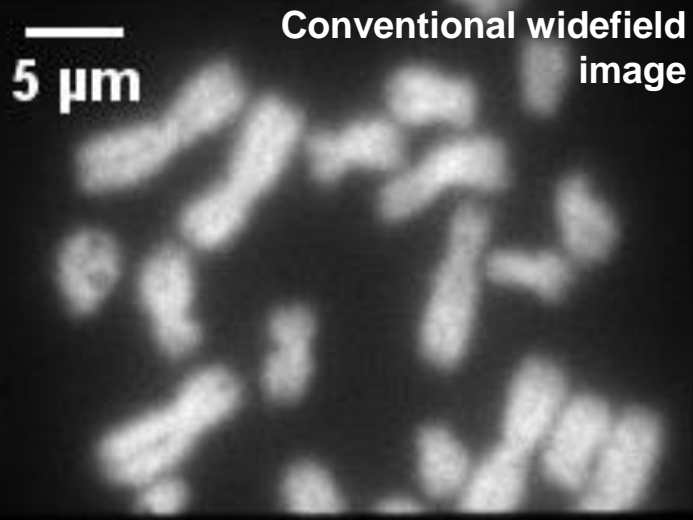
Science & Technology
Facilities Council

Lasers & Life Science

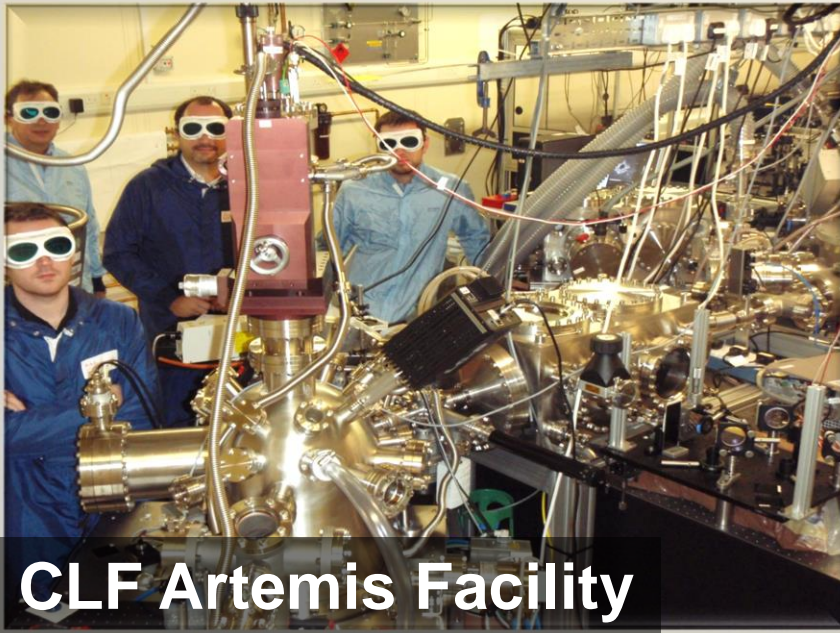
CLF has developed facilities in the new cross council Research Complex to peer deep inside cells to reveal their internal workings – fundamental to understanding e.g. cancer



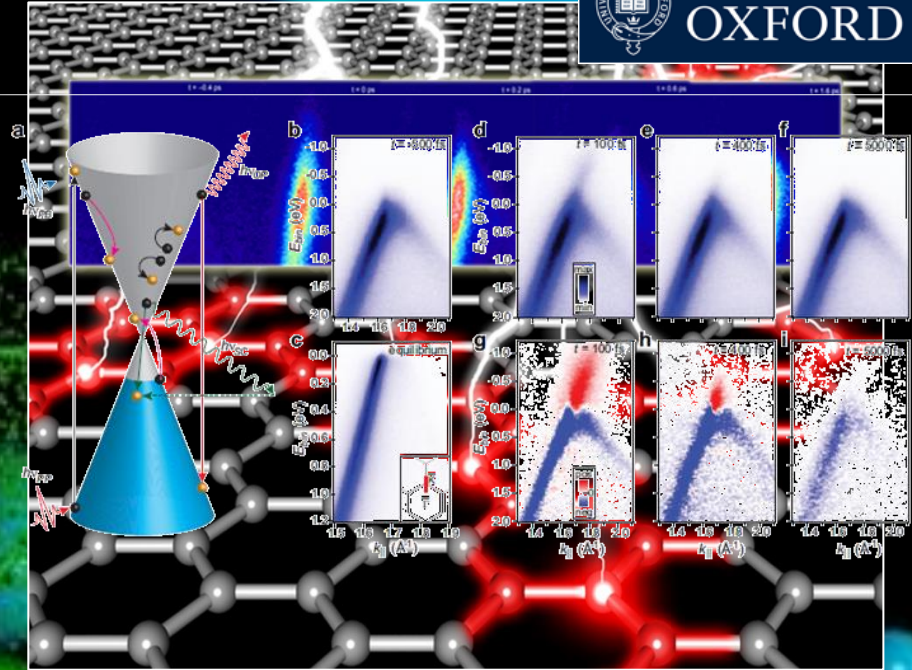
Super-resolution Imaging



CLF Lasers for extreme dynamics (as)



CLF Artemis Facility



- Graphene has unique optical properties, that could lead to many applications in optoelectronics
- Recent CLF experiments have made first direct measurements of electron dynamics
- Shown “population inversion” i.e. potential laser in THz regime and potential solar cell use.

CLF Innovation Example - Aviation Security



- Specialist lasers, invented at CLF, can “see through” plastic & glass bottles



- Patented & commercialised as liquid explosives detector
- Will have major impact on airport security and our travel – no more 100 ml

Will be widely seen in airports around the world from 2014

Even seeing through skin



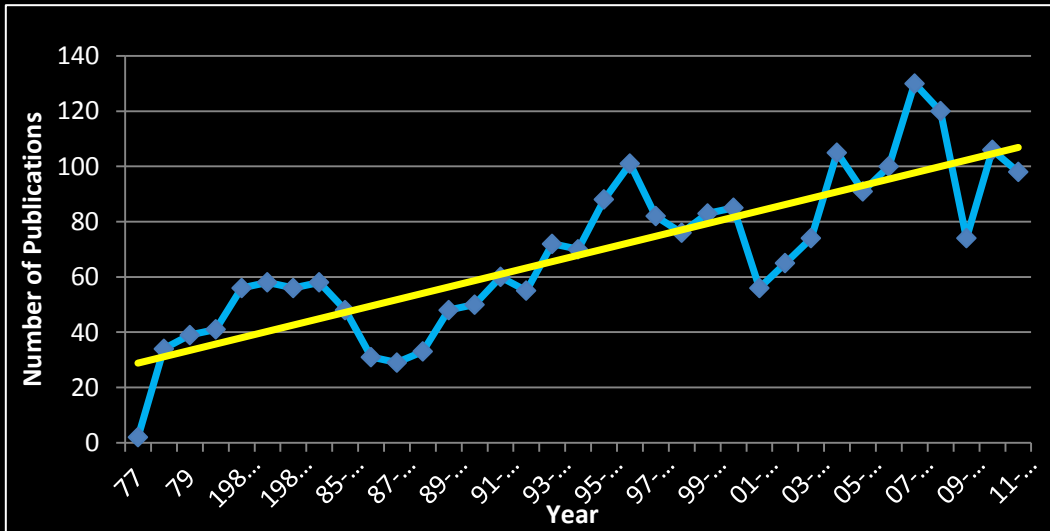
- **Osteoporosis affects 1 in 3 women over 50**
- **Undiagnosed cases cost the NHS more than £1 Billion per annum**
- **Clinical trials are underway to see through skin to diagnose bone conditions**
- **This uses the CLF patented techniques**

Since 1977

Global Community



Scientific Diversity & Excellence



Economic Innovation



Advanced Skills



Godfrey Stafford's legacy...

