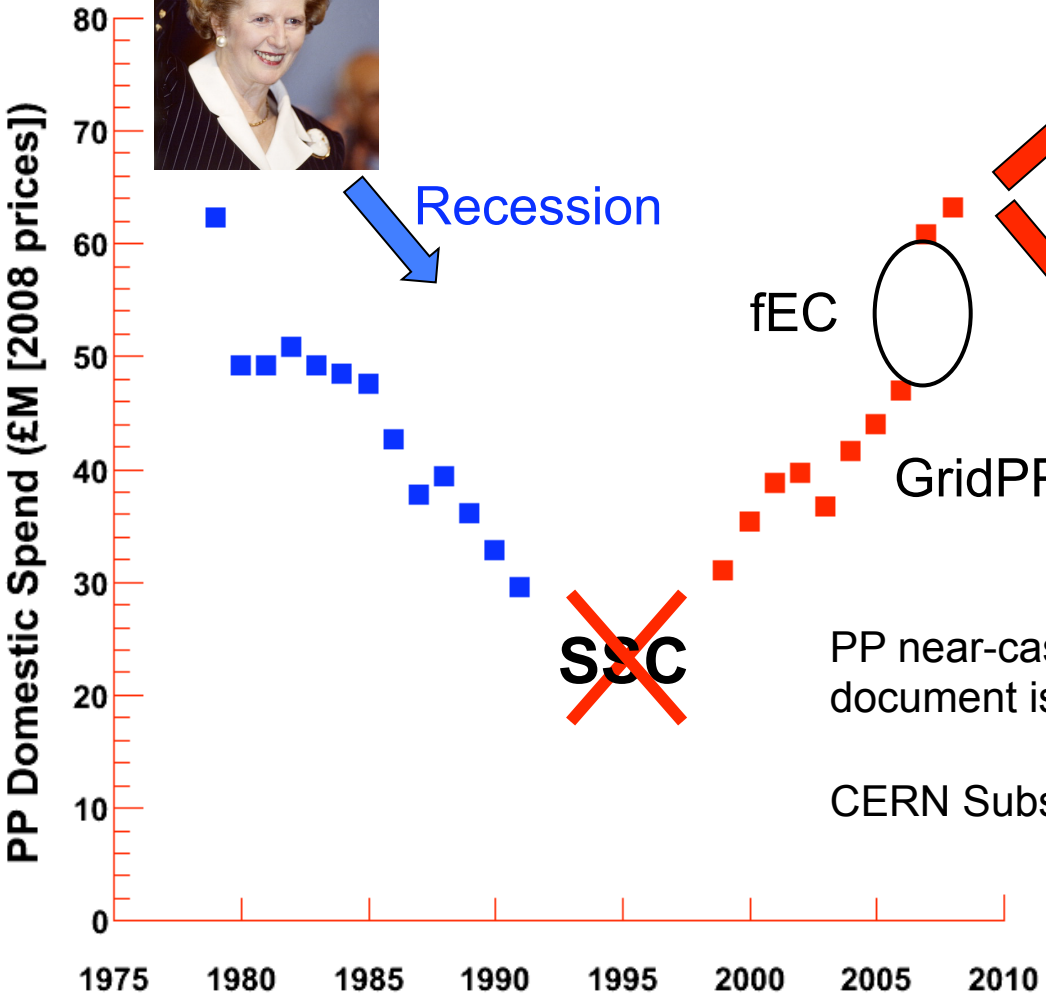
PP2020

Selling Particle Physics to The Treasury

Mark Lancaster - UCL

The Concern – The Bad News



PP near-cash spend in STFC strategy document is 25% of £432M (2008/9) = £108M

CERN Subscription = £80M; Rest = £28M.

The Good News

" For the last time Mother.No,I can't arrange to have you foceably returned to power ! "

The word “science” did not appear once in the Conservatives’ 2005 manifesto.

www.conservatives.com/pdf/stemreportfinal.pdf

Some Figures Closer To Home

Can be spun many ways but there has been a 15% reduction in funded PP posts in last 3 years.

Since 1996 there has been a 25%+ reduction in RG posts; offset slightly by new “project” posts.

No sign of STFC’s deficits getting smaller – 25%+ cuts are on the horizon.

STFC’s slice of the RCUK pot diminished in CSR07.

2009 CERN subscription is 161 CHF = £98M
In 2008 it was £79M : £16M hole being negotiated with DIUS.

Some Figures Closer To Home

The entire PP exp+theory rolling grant spend is £30M/year…

Ratio of PP grant spend/CERN subscription is declining.

We are clearly in for a difficult time and can't ignore juggernaut.

> "for example I have heard leading particle physicists and astronomers defend the importance of their fundamental science because of its impacts …..
> However many of the same scientists also express suspicion about what they feel is a growing expectation by government that they should be judged in part by, and expected to increase, those kind of impacts" – Keith Mason.

- We're doing the science because it fascinates and enthralls us but whether we like it or not we will have to be better versed in selling PP, to retain a slice of the pie but relying solely on KE won't win the day.

Enter PP2020

- Tension of how much to push KE is not a new one

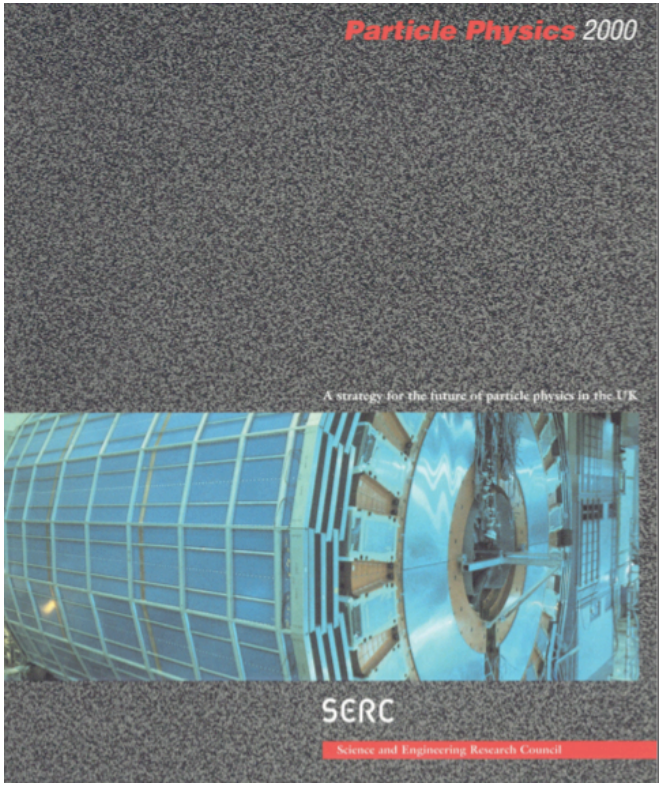
"We remain concerned, however, that the correct balance be maintained between the current emphasis on the industrial relevance of research and the pursuit of new knowledge which is not perceived to be of immediate application. World class excellence in Science and Engineering has been a central feature in our national culture for more than two centuries and we urge that fundamental research should continue to be accorded the highest priority as we move towards the new Millennium" : Oxford Instruments 1999.

Idea of PP2020 was to refresh the arguments, case studies and figures to demonstrate the need for particle physics.

Ongoing and evolving process.

Not New

-We're learning tricks / arguments from our peers



Roger Cashmore

David Saxon

Governments are interested in benefit; People Science

"To invent an infallible remedy against toothache, which would take it away in a moment, might be as valuable and more than to discover a new planet…. But I do not know how to start the diary of this year with a more important topic than the news of the new planet" Christof Lichtenberg, January 1782

Socrates: Shall we set down astronomy among the subjects of study?

Glaucon: I think so, to know something about the seasons, the months and the years is of use for military purposes, as well as for agriculture and navigation

Socrates: It amuses me to see how afraid you are, lest the people should accuse you of recommending useless studies
Plato, the Republic (380 BC)

PP2020 Membership

Phil Allport	- Liverpool [KE group]	Tim Gershon	- Warwick
Alan Barr	- Oxford	Mark Lancaster	- UCL
Iain Bertram	- Lancaster	Chris Parkes	- Glasgow
Grahame Blair	- RHUL	Silvia Pascoli	- IPPP
Cinzia DaVia	- Manchester	Nigel Smith	- RAL*
Gavin Davies	- Imperial	David Tong	- Cambridge

KE Group

Phil Allport	Detector Development (Liverpool)
Barbara Camanzi	Cancer Therapy (RAL PPD)
Mike Poole	Director ASTeC (Accelerator Science) STFC
Tim Short	Ex-Particle Physicist (Banker)
Marcus French	Head of RAL Microelectronics STFC
Jason McFall	Ex-Particle Physicist (Computing)
Val O'Shea	Detector Development (Glasgow)
Steve Lloyd	e-Science (QMUL)
Stephen Watts	Detector Development (Manchester)

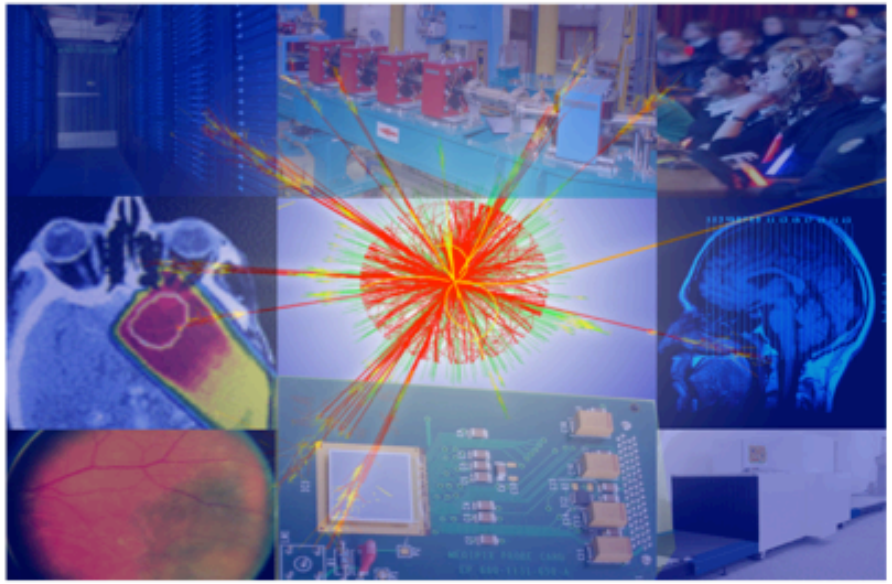
Outputs

FUNDAMENTAL IMPACTS

A Study of the Cross-Discipline and Societal Benefits of UK Research in Particle Physics

Institute *of* **Physics**

High Energy Particle Physics Group



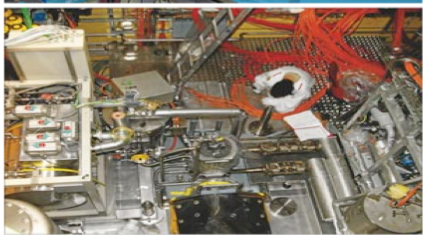
30 page document to Wakeham Panel

http://www.pp2020.info

8 page + then 2 page glossy to be signed off on Friday by IoP.

Outputs

http://www.pp2020.info



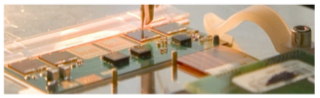
Advanced Accelerator Techniques

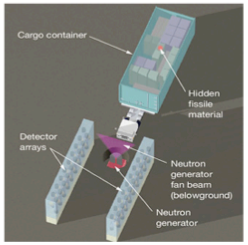
At least 10 types of accelerator originated from Particle Physics research.

NS-FFAG technology, proposed for neutrino factories, and being prototyped at Daresbury, have the potential to provide proton and ion cancer therapy with smaller, simpler, and higher duty-cycle accelerators that could be based at hospitals. This technique offers the best potential for treating **cancers** in children & sensitive organs such as the eye and spinal cord. High-power proton accelerators can also be used to provide intense neutron sources for material science and to **transmute nuclear waste** and ultimately, with a thorium target, to sustain a **sub-critical nuclear reactor** with doesn't produce any significant Plutonium.

Advanced Micro-Sensors

Developed for the CERN LHC have a wide variety of **medical imaging** applications. 0.5 million people in the UK suffer macular degeneration which causes loss of sight particularly in older people. CMOS active pixel sensors can be utilised as **retinal implants** to provide electrical signals thereby partially restoring sight.





Advanced Computing

Distributed (grid) computing and large-scale data management & storage techniques developed for the LHC are now routinely used to develop drugs. 2 milllion hrs of CPU were recently used to search 140 million potential **malaria drugs** & to develop drugs to combat avian flu. The evolution of marine biological communities & their impact on **climate-change** has recently been simulated on the grid.

Advanced Detector Technology

Neutrons interacting with **fissile nuclear material** produce distinctive gamma radiation which can be detected with sensitive liquid scintillator/PMT detectors of the type used in neutrino experiments.
Scintillating crystals and Particle Physics detectors are now being tested that provide **real-time, whole-body PET scanners** with improved resolution.

Arguments from 2008…..

We provide a lot of bankers ….

We have employed a number of PhDs in particle physics at aAIM and we have found them to be highly flexible and numerate, with an analytic mindset and the type of international experience which enables them to make a significant contribution very quickly. We would definitely like to see more people with this background becoming available for employment in the City."
Mark Tagliaferri – Chairmna aAIM Group

From The Times

December 4, 2008

Celebrity crunch: property firm to the stars, aAim, goes bust

Arguments being sold

Cultural Benefits

Education Training

"It has not security benefit except
To make the country worth defending"
- R. Wilson

There is no Knowledge Transfer without knowledge

Technological Innovation Enhancing Industrial Capability

Not one single argument will win the day – need all three.

Remind People How the Modern World Came About

"I have heard statements that the role of academic research in innovation is slight. It is about the most blatant piece of nonsense it has been my fortune to stumble upon.

Or whether, in an urge to provide better communication, one might have found electromagnetic waves. They weren't found that way. They were found by Hertz who emphasised the beauty of physics and who based his work on the theoretical considerations of Maxwell. I think there is hardly an example of twentieth century innovation which is not indebted in this way to basic scientific thought."

H. Casimir – Research Director at Phillips

Remind People How the Modern World Came About

"By research in pure science I mean research made without any idea of application to industrial matters but solely with the view of extending our knowledge of the Laws of Nature. I will give just one example of the "utility" of this kind of research, one that has been brought into great prominence by the War - I mean the use of X-rays in surgery….

Now how was this method discovered? It was not the result of a research in applied science starting to find an improved method of locating bullet wounds. This might have led to improved probes, but we cannot imagine it leading to the discovery of the X-rays. No, this method is due to an investigation in pure science, made with the object of discovering what is the nature of Electricity."
J.J. Thomson 1916

As with all good arguments:

"Thermodynamics owes more to the steam engine than the steam engine owes to science"

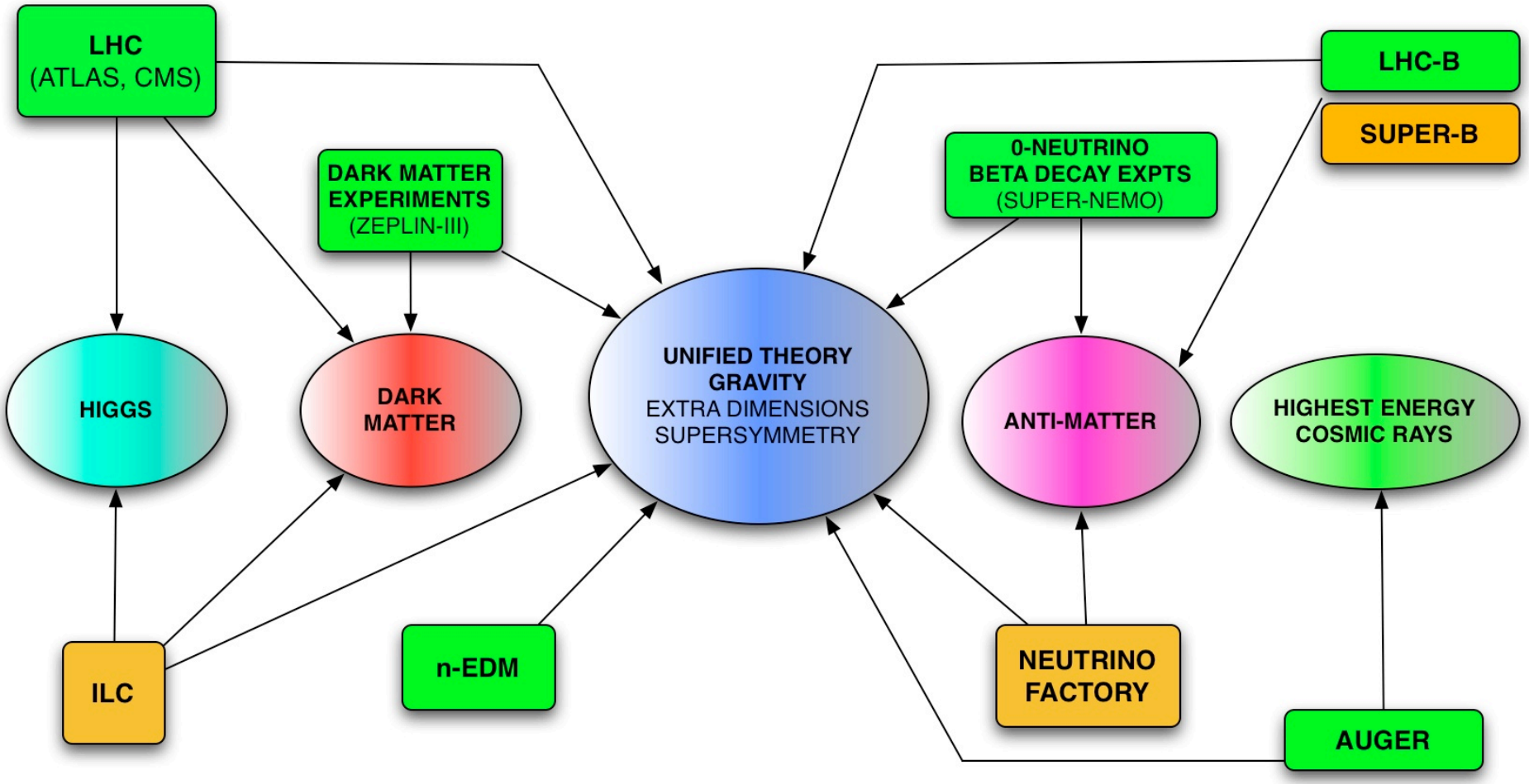
Arguments being sold

1. The subject is not over despite the imminent start of the LHC

   - as we've seen today there are now and will after the LHC remain many interesting questions requiring multiple experiments and each will require new technology and a **flux of young scientists** to carry it out.

Science Case

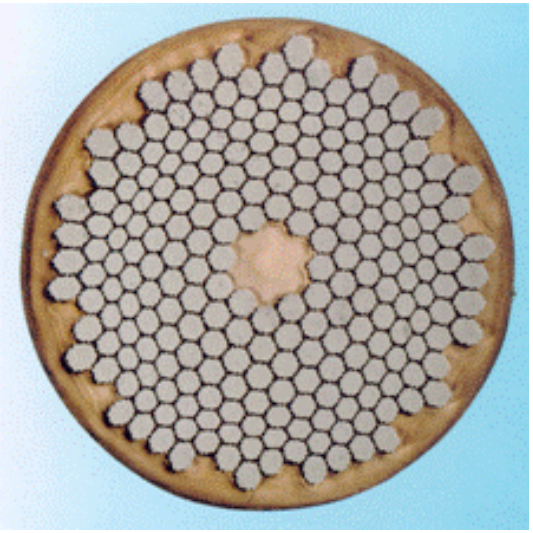
- articulated very clearly and strongly today.
- it is interesting to the public – 25% of New Scientist covers feature these same questions & sales increase by 10-15%



Arguments being sold

While it is simplistic and in many cases stupid – we probably need to prepare arguments for future facilities that also include a KE aspect (which politicians can understand) and highlight what came out of past facilities.

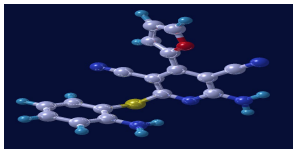
"Every program in super-conductivity that there is today owes itself in some measure to the fact that Fermilab built the Tevatron and it worked" : Robert Marsh US Nb-Ti manufacturer.



- 500 million miles of s/c fibre in LHC !
- super-conducting magnets are a $5B/pa business.

Advancing Technology

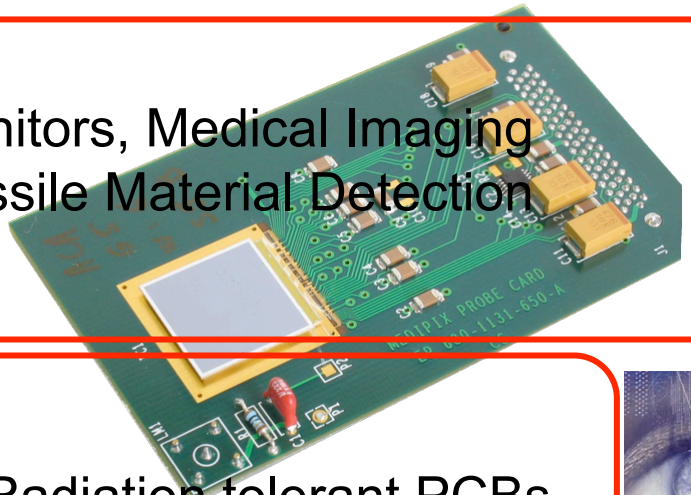
Accelerators



Cancer Therapy; Pharmaceutical Imaging
Food Sterilisation; Nuclear Waste Transmutation
Nuclear Thorium Reactors
Ion Doping of Semiconductors

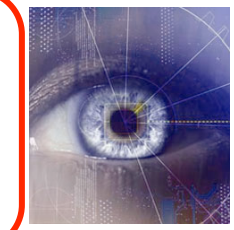
Detectors

Radiation Dose Monitors, Medical Imaging
Cargo scanners, Fissile Material Detection



MicroElectronics

Eye Implants, Radiation tolerant PCBs
Pixel medical detectors

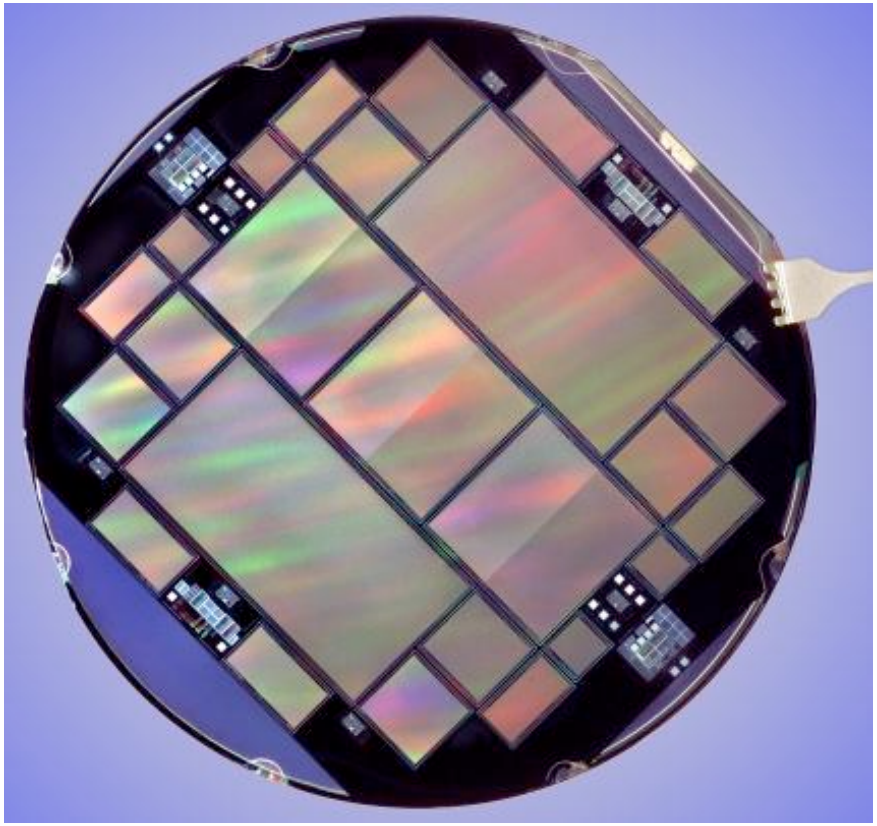


Computing

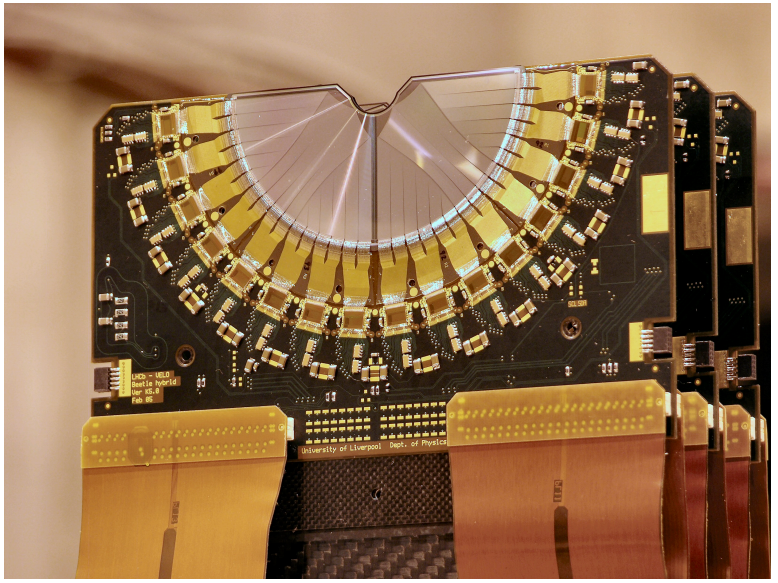
New drug simulations
Design of new medical treatments

Next Facilities

ILC – improve CCD technology by x100



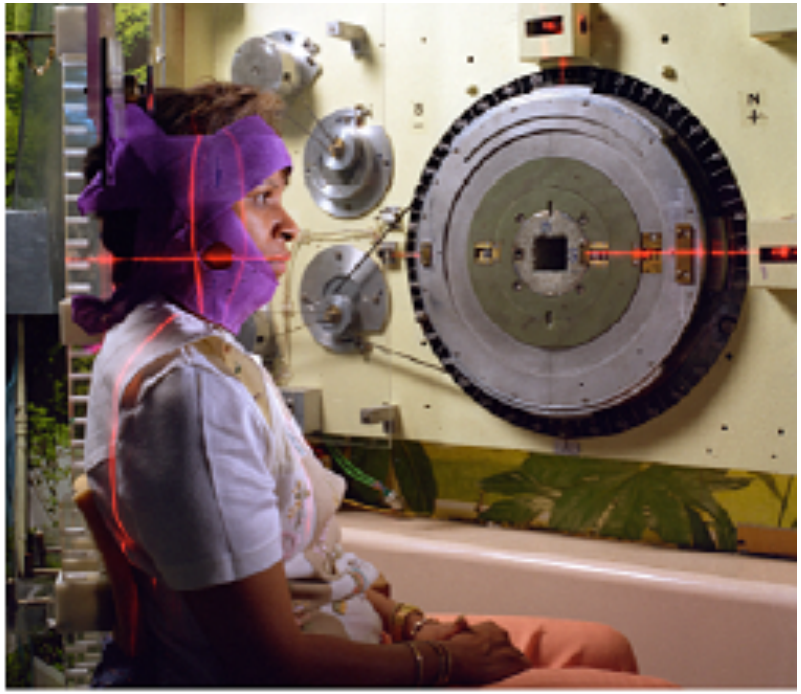
sLHC – sub-micron CMOS active pixel sensors

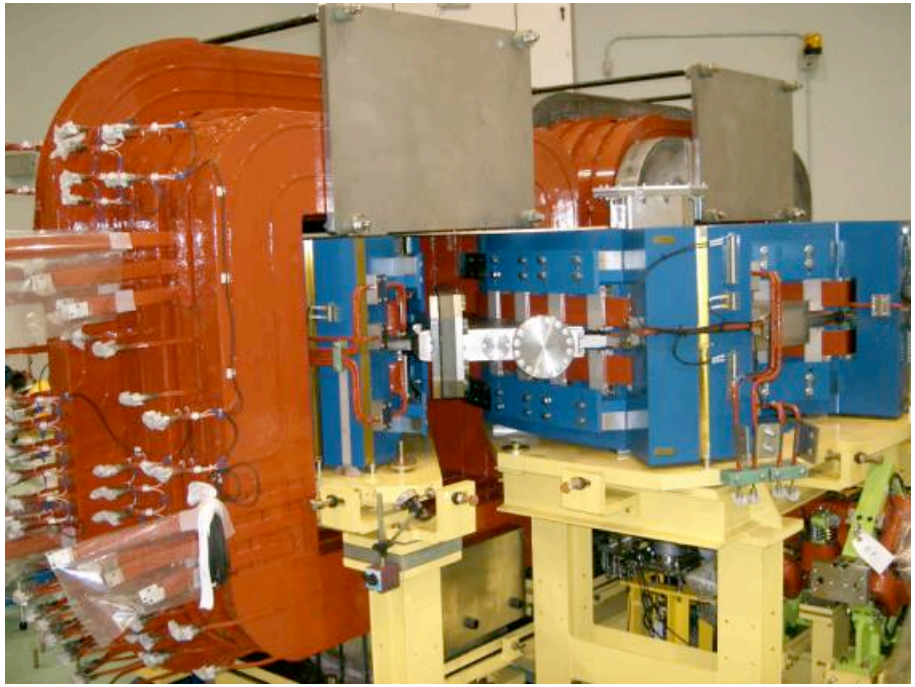


Next Facilities

Neutrino Factory / Muon Collider

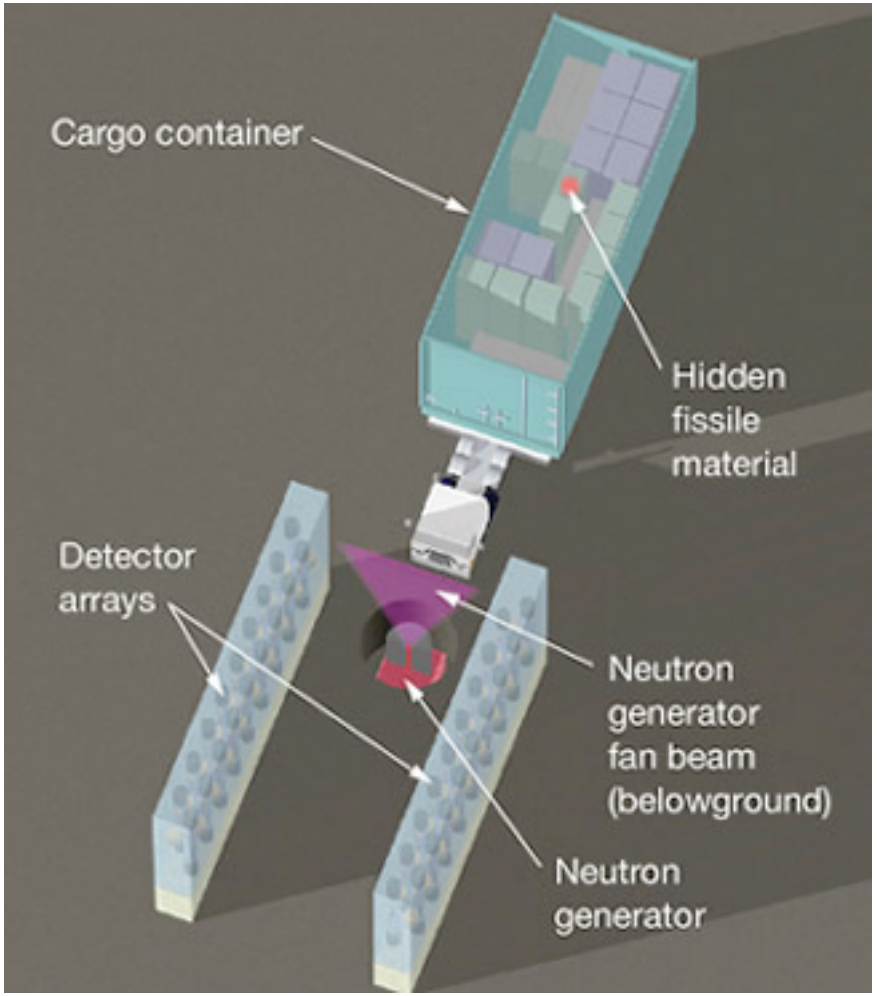
- fast acceleration : FFAG accelerator - **HADRON THERAPY**
- high powered proton sources – **CLEAN NUCLEAR POWER**





Not just Accelerator Experiments

Low background experiments – low noise/fast scintillators



Arguments being sold

Technology arguments alone need to be carefully articulated:

2. It is people's interest in the science that motivates them to innovate in technology.
   - we need to counter the argument that if we are so good at useful technology why don't we just concentrate on that

3. The research requires paradigm shifts in technology
   - the electric light bulb didn't come from incremental R&D in candles.

March 06 – ½ day IoP Meeting
http://www.hep.ucl.ac.uk/~jthomas/KE/ke.html

Education / Training

At the moment this is one of the strongest sellers for the Government.

Next 10 years – need an increase of 33% in STEM graduates to retain competitive edge

The subject captivates the public and school-children and draws students in to study physics.

UG Survey

UG survey : 830 1st & final year students at 8 universities

The question: ***Which aspects of physics attracted you to the subject ?***

Subject Area / % interest	No Interest	Some Interest	Significant Interest
Mathematical aspects	11	44	45
Fundamental Particles, Quantum Phenomena	5	22	73
Mechanics & Kinetic Theory	6	55	39
Electricity & Magnetism	14	63	23
Properties of Solids	37	52	11
Waves and Optics	21	60	19
Nuclear Physics	4	35	61
Astrophysics	12	34	54
Medical Physics	55	34	11
Electronics	36	49	15
Applied Physics	11	57	32

90% expressed a significant interest in at least one STFC area

Only 37% expressed a significant interest in applied/medical physics

Final Year UG Survey

71% had significant interest in at least one STFC science area

PP lowest no interest and highest significant interest

Q2. If you intend to continue physics research, which areas of current physics research are of interest ?

	No Interest	Some Interest	Significant Interest
Atomic & Molecular Physics	19	68	13
Lasers, optics & photon Physics	34	51	15
Particle Physics	11	43	46
AstroPhysics/Cosmology	27	33	40
Superconductors/fluids	47	45	8
Nuclear Physics	18	48	34
Materials, nanotechnology, condensed matter Physics	43	37	20
Quantum computing/communication	35	45	20
Medical/Biological Physics	54	33	13
Environmental Physics / Renewable energy	35	44	21
Geo-Physics	66	26	8

89% : some/significant interest

Government priorities

Economic Impact Studies

2006 – Warry Report has spawned buzzword bingo, revenue to highly-paid consultants and few useful statistics.

Excellence With Impact

The Race To The Top

Innovation Nation

Fundamental Impacts !

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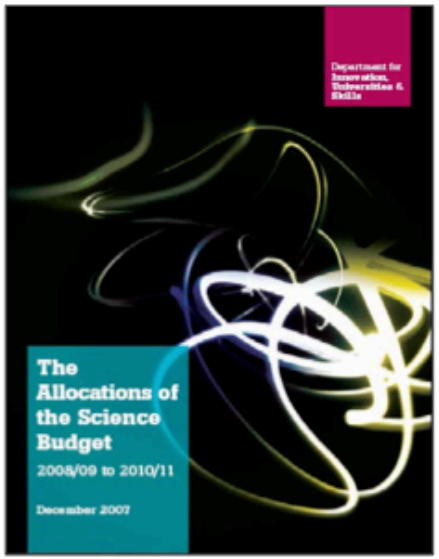

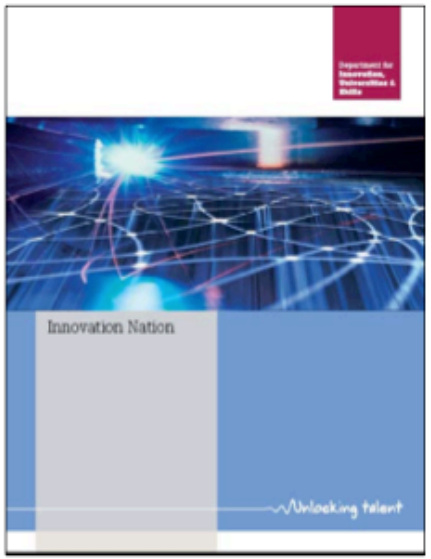

Economic Impact Studies

1. PA Consulting for RCUK (Oct 2007)
   - salaries of ex-PPARC students (not compared ….)
   - list of PIPPS awards
   - quantifying economic impact (£50k/life) early cancer detection

2. STFC : Liz Towns-Andrews, Claire Dougan
   - picking specific examples – non PP.
   - SRS – 200M spin-out company
     - benefit of understanding mad cow disease (“billions”)

3. IoP with RAS/STFC
   – again picking certain areas
     - so far “flexible plastic display panels”
     - next hopefully superconductor technology (PP)

Economic Impact Studies

4. UCL Institute of Fiscal Studies

- aim is to get help from academic economists not consultants
- dangerous – we may not get the answer we want !

There are areas where in PP we can say:

"X would have been invented but because of PP it was invented Y years sooner"

As such we can quantify the economic benefit from Y. Examples where X is invented out of nowhere are less tractable for economists.

The Web, Superconducting Cables being good examples.

Economists are interested to use a "nested multinomal logit" as the metric

- now becoming accepted as a robust standard based on work that was done to quantify the "value" of CT scanning.

We are hoping to secure funding from STFC/RCUK for economics PhD.

Some Good News Before the Pub : US Stimulus Bill

FYI: The AIP Bulletin of Science Policy News

House Economic Stimulus Bill Would Provide Billions in New Science, Energy, and Education Dollars

New research facilities : $0.3 B
Restore NSF funding to pre-2000 levels : $2.5B (+35%)
Additional DOE funding : $2B (+50%)

Lord Drayson argued that jobs which depend on science and maths skills will increase by around a third over the next decade.

"The reality is that we need more people being interested in and being good at science if we are going to develop as a country," he insisted.

Summary

Don’t get depressed – it’s always been like this !

But we are in competition for funds and we need to have the arguments ready and for more people to be versed in them for the elevator pitch.

And we need to fight flabby thinking in STFC. It’s not all KE despite what I’ve said.

If you’re interested in helping – get in touch.

www.pp2020.info - watch this space.

CASIMIR RANT

"I have heard statements that the role of academic research in innovation is slight. It is about the most blatant piece of nonsense it has been my fortune to stumble upon.

Certainly, one might speculate idly whether transistors might have been discovered by people who had not been trained in and had not contributed to wave mechanics or the quantum theory of solids. It so happened that the inventors of transistors were versed in and contributed to the quantum theory of solids.

One might ask whether basic circuits in computers might have been found by people who wanted to build computers. As it happens, they were discovered in the thirties by physicists dealing with the counting of nuclear particles because they were interested in nuclear physics.

CASIMIR RANT

One might ask whether there would be nuclear power because people wanted new power sources or whether the urges to have new power would have led to the discovered of the nucleus. Perhaps - only it didn't happen that way.

One might ask whether an electronic industry could exist without the previous discovery of electrons by people like Thomson and H A Lorentz. Again it didn't happen that way.

One might ask even whether induction coils in motor cars might have been made by enterprises which wanted to make motor transport and whether then they would have stumbled on the laws of induction. But the laws of induction had been found by Faraday many decades before that.

Or whether, in an urge to provide better communication, one might have found electromagnetic waves. They weren't found that way. They were found by Hertz who emphasised the beauty of physics and who based his work on the theoretical considerations of Maxwell. I think there is hardly an example of twentieth century innovation which is not indebted in this way to basic scientific thought."