

Strategy for engaging the UK public with the Large Hadron Collider programme (Updated 29 January 2008)

1 Background

The programme of experiments at CERN's Large Hadron Collider (LHC), due to begin in summer 2008, is likely to bring new light on the workings of the universe. Physicists expect that the LHC, the highest-energy particle accelerator ever built, will yield detailed information on the Big Bang, on the structure of the cosmos, on the fundamental particles of matter and the forces between them, and possibly on black holes. Most exciting of all is the possibility of unexpected experimental discoveries that will cause scientists to rethink their understanding of nature.

This is an excellent opportunity to engage the public, especially teachers and young people, with particle physics. STFC is realizing this opportunity by leading a public engagement programme that seeks to maximise:

Public accountability Over the thirteen-year design-and-construction period of the project, the total UK contribution will be approximately £0.5 billion (details in Appendix 1). It is important to account publicly for this money and demonstrate that the expenditure is good value.

Openness and dialogue The project, especially the work of participating British scientists, should be readily accessible to interested citizens. Provision should be made for citizens to discuss issues - notably ones that are of special interest to the public - with experts.

Support for the Government's Science and Innovation Strategy The intriguing 'big questions' that underlie the LHC programme offer many opportunities to enthuse teachers and young people. If these opportunities are taken, one consequence will be the recruitment of a higher proportion of young people in the UK to the study of science and technology, as the Government intends.

Support for modern physics The programme offers numerous opportunities to raise public awareness of the benefits of physics-based activities to UK science, culture, education, industry and the knowledge and technology bases.

The four-year programme that this document describes is led by STFC in partnership with the UK particle physics community. It is a broad and robust framework of carefully targeted initiatives that seek to engage the public with the LHC project. The programme will stimulate engagement activities by physicists and others, and will increase both public knowledge and support for particle physics. We hope that this increase will be large enough to be measurable. The programme will endeavour to inspire young people and thereby increase recruitment to undergraduate courses in physics.

2 Messages and target audiences

The principal messages that the strategy will communicate are:

- 1 The LHC is an extraordinarily ambitious facility – one of the biggest ever built by scientists – that seeks to shed light on some of the most fundamental questions in science
- 2 The LHC will enable scientists to recreate – fleetingly and in tiny regions of space - the conditions that existed in the universe within a millionth of a millionth of a second after the beginning of time, during the Big Bang
- 3 It is an exciting international venture that involves thousands of people from dozens of countries collaborating harmoniously; the UK has a leading role
- 4 There are valuable technological spin-offs from this type of work: a classic example is the invention of the World Wide Web at CERN
- 5 A vital part of the LHC project is the Grid, an international cutting-edge computing resource that enables the processing of massive quantities of data from the LHC detectors
- 6 The scientists involved are keen that the public, whose funding has made this facility possible, share the excitement of this adventure
- 7 Young people, from every background and with many different talents, can be part of scientific activities like this if they study physics and closely related subjects
- 8 British industry benefits from this project, and can benefit further from future projects in particle physics
- 9 For a reasonable investment from the public purse, the project will tell us fundamental things about the way the universe works

The detailed messages of the public engagement programme are given in Appendix 2.

The three main target audiences for the programme are:

- **public** The media, especially television and high-profile newspaper articles, are the most effective way of reaching large numbers of people. According to survey data, about twenty per cent of UK adults (about eight million people) are disposed to be interested in new scientific developments.
- **policy makers and opinion formers** It is crucial that Members of Parliament and the House of Lords, as well as government officials, are clear about the great value of this research, in intellectual and economic terms, as well as the inherent prestige. It is crucial to win the support of opinion-formers in order to reach all other audiences through the media.
- **students aged 14-16** These are the students who are reflecting on the subjects they would like to study at university: it is vital that we persuade more of them to choose physics. Other important audiences, though ones with a slightly lower priority, are gifted 12-14 year-olds and students in the age range 16-18 who are already studying science at post-GCSE-level and whom we hope will continue to study physics, mathematics or engineering. In order to inspire these students, it is essential to win the active support of their teachers.

We intend the strategy to make a national impact with these three groups. At the conclusion of the project, the sustainable legacy of this strategy should be:

- greater awareness in the media of the excitement of particle physics
- a higher level of skill among particle physicists in dealing with the media
- more particle physicists interested, and active, in public engagement activities
- increased awareness in UK industry of the commercial opportunities at CERN
- substantially increased political support for particle physics.

3 Communication programme

The programme includes the following components to reach the target audiences with the appropriate key messages. Clearly different levels of engagement will be achieved among the audience sectors:

Formative evaluation In Summer 2006, STFC commissioned a formative evaluation research project to study the knowledge, views and perceptions of physics and particle physics among the general public, teachers and students. The results of this project are informing the development and content of the LHC engagement strategy. The evaluation report was published in October and is available at www.pparc.ac.uk/ed/LHC.asp

TV and radio coverage By cultivating producers and programme makers, STFC is seeking to encourage the making of high-profile programmes on experiments carried out at the LHC facility (aiming for two major features on terrestrial TV and three on non-terrestrial networks), as well as news and popular daytime programmes when results are announced. (Targets all audiences; potential audience ca 4 million)

Support for journalists STFC has a programme of visits to CERN for journalists. STFC will build on this work to engage journalists with the LHC, and to keep them informed, enthused and up to date with new developments. A media event will be held in 2007, when the machine is 'switched on', and another will be held soon after the first results have emerged, probably in 2009.

A library of film and still images of UK equipment and scientists is being assembled. Also, images of UK equipment and UK scientists involved in the LHC programme have been commissioned. (Ultimately targets public and opinion formers; public audience 2 million)

National Schools' Programme This will support science teachers in bringing the LHC programme into schools. The activities will include: briefing for teachers (CPD and talks for teachers); specially produced packs of information, web and multi-media materials for use by teachers; portable demonstrations and a lecture (or lectures), which will be available to visit schools all over the country, from mid-2007. A series of three 15-minute TV programmes that explore the LHC project and its historical background have been commissioned from a specialist production company. (Ultimately targets students; potential audience ca 0.25 million)

National touring exhibition This will be presented at the Science Museum in London from April to September in 2007 and, in the following year, a smaller version will tour to at least four venues across the UK. The Touring Exhibition will be supported by additional activities involving physicists in debate and interaction with the public and schools. (Targets mainly public and students; related Website and special events; audience ca 0.5 million)

Website The project's website (www.lhc.ac.uk) was launched in January 2007. This will evolve into a portal for top-quality information (text, photographs, podcasts etc.) about the LHC programme and scientists involved in it. The vision for the site is that it will become the best source of information about the UK's contribution to the LHC (targets all audiences; potential audience 1 million)

Receptions for VIPs and opinion formers These will be held in London. A breakfast meeting of the Parliamentary and Scientific Committee in spring 2007 introduced the LHC to MPs. Another reception will mark the 'switching on' of the machine and alert attendees to the excitement that should soon be forthcoming. Other events during the first years of the facility's operation will highlight achievements. (Targets mainly policy makers; potential audience 400)

Public events across the UK From early 2008 a programme of at least eight public gatherings involving scientists and the public to share the excitement of discovery and discuss LHC science (locations will include science centres and Cafés Scientifiques). The events in London and Edinburgh will have an especially high media profile as they will be organized in collaboration with national newspapers and will be covered by radio and TV. The LHC will feature in a day of public talks at the BA Festival in 2007 (organised by STFC and the Physics and Astronomy Section of the BA). It is hoped to also feature the LHC at the BA Festival 2008. (Targets public; direct audience 1000 plus ca 0.1 million via media coverage)

Support for physicists The programme will promote to the physics community opportunities for media and communication training, access to funding (STFC small and large awards), and the availability of free publications and professional advice. It will seek to facilitate the exchanging of ideas and resources, and partnerships between physicists and science communicators.

The programme targets UK audiences, but is coordinated with similar activities in other CERN partner states, primarily through CERN and the European Particle Physics Outreach Group. It is intended that the expertise and resources developed through this programme will be freely disseminated.

1 Organization

The programme is a partnership that involves researchers, science communicators, evaluators and STFC & CERN officials. It is coordinated by Ray Mathias, an expert in

science communication, employed half time by STFC. The programme draws on the expertise and resources of STFC's Science and Society, Press Office, Public Affairs and Particle Physics Funding teams.

Key parts of the programme are/have been:

- Taking journalists to CERN and the LHC during its construction. A library of television footage and high-quality still photographs is being prepared, to aid programme makers and journalists.
- In summer 2006, the commissioning of a formative evaluation study involving representative focus groups of the public, teachers and students. The report was completed in October 2006 and is available at www.pparc.ac.uk/ed/LHC.asp
- There is a continuing media training programme to ensure the media have access to articulate and 'media-friendly' particle physicists, of both sexes and from a variety of cultural backgrounds.
- The launch in January 2007 of a new website www.lhc.ac.uk, describing the LHC project and especially the UK's role.

2 Conclusion

The total cost of the communications programme, which we envisage will run until early 2009, is less than 0.2 per cent of the UK's total contribution to the LHC programme and is therefore excellent value. The price of *not* properly promoting the project—of not sharing our excitement with the public and with the UK physicists of the future—would be incalculable. We therefore view this programme as an inexpensive but crucial investment in the future of particle physics in the UK.

29 January 2008

Appendix 1 Direct financial costs of the UK's participation in the LHC programme, and the foreseeable returns

Direct financial costs

Over the 13 year design and construction period (from 1994 to 2006 inclusive) the total UK contribution to the detectors and GridPP (includes materials and staff costs) and LHC collider, is £511M.

This £511M is made up of:

- UK's £342M contribution to the cost of building the LHC collider (16.3% of the total cost to CERN of 4.7B CHF over 13 years) and,
- UK's £169M contribution to the detectors and GridPP (includes materials and staff costs).

The total annual cost to the UK of ongoing participation in the LHC project (participating in the physics experiments) will be £108M. This includes the UK's annual subscription to CERN (currently £82M).

Financial returns:

Over the thirteen-year construction period, the UK has won £227M in CERN contracts. This is 7% of all the service and supply contracts awarded by CERN to the Member States (not just those associated with LHC construction). This contrasts with our 16.3% contribution to the CERN budget. The UK has systems in place to support improvements in the success rates of UK companies bidding for contracts.

Cost comparisons:

The total cost to UK of the LHC construction project (£511M) compares with:

£80M per Eurofighter Typhoon. The RAF will purchase 232 at £19 billion
http://en.wikipedia.org/wiki/Eurofighter_typhoon.

£472M for 4 jumbo jets (£118M, unit cost of 747-400)

http://en.wikipedia.org/wiki/Boeing_747

£800M for the St Pancras station re-development (<http://observer.guardian.co.uk>)

£4.3B for Heathrow Terminal 5 (www.bbc.co.uk)

£757M for the new Wembley stadium (<http://www.wembleystadium.com/>)

UK expenditure on the LHC is less than the cost of a pint of beer or 2 loaves of bread per UK adult per year.

£140M was spent on cat litter in UK in 2005 (AMA Research)

£438M was spent on deodorants in UK in 2006 (www.cosmeticsbusiness.com)

£5B was bet on the National Lottery in 2005/06 (www.camelotgroup.co.uk)

Comparisons with health spending:

£100M approximate net annual operating costs of a 500 bed NHS trust hospital (e.g. Queen Elizabeth Hospital, Kings Lynn, 2005/06)

£220M approximate net annual operating costs of Swindon Primary Health Care Trust (2005/06)

Appendix 2 Detailed messages of the public engagement programme

The LHC is an extraordinarily ambitious facility – one of the biggest ever built by scientists – that seeks to shed light on some of the most fundamental questions in science

[the notes in square brackets refer to the topics in particle physics that underlie the message]

- The LHC is one of the biggest facilities ever built for scientists
- For the first time, it will enable people on Earth to create at will the same conditions as the universe when it was only a millionth of a millionth of a second old, during the Big Bang
- It will shed light on how fundamental particles originally interacted to produce a universe apparently made of matter not anti-matter [asymmetry of matter and anti-matter]
- It will help us understand if there was a previously unidentified form of matter at the beginning of the universe [quark-gluon plasma]
- It will help us find out about the 96 per cent of the universe that is unaccounted for and the ultimate fate of the universe [dark matter]
- It will help us understand why the universe is built the way it is, and whether it could have been built any other way [standard model; supersymmetry]
- It will help us to see whether there is a deep symmetry at the heart of nature [supersymmetry]
- It should to help us understand why things have mass and are not as insubstantial as light [Higgs boson]
- It may reveal that there exist previously unobserved dimensions, in addition to time and three-dimensional space (supersymmetry)
- It may shed light on the most familiar force of all, gravity, for example by creating short-lived black holes [theory of gravity]

It is an exciting international venture that involves thousands of people from dozens of countries collaborating harmoniously; the UK has a leading role

- CERN is a hugely successful scientific research laboratory, mainly a European venture
- 85 countries participate, including the UK, which contributes hundreds of scientists and engineers, many of them PhD students
- It runs smoothly and with little friction – a genuinely successful collaboration
- Among the leading UK people involved in the story are Lynn Evans (project manager) and Peter Higgs (theorist).

There are valuable technological spin-offs from this type of work: a classic example is the invention of the World Wide Web at CERN

- British scientist Tim Berners-Lee invented the Web when he was working at CERN to facilitate the sharing of information among scientists who were collaborating but based in locations all over the world
- Grid computing is already used in drug discovery and biomedical research. The initial development of Europe's largest science Grid was driven by the need to process the huge amounts of data produced by the LHC experiments.
- Small scale particle accelerators are used in hospitals to produce beams for radiation therapy
- Accelerators are widely used industry, e.g. in the production of semiconductor chips and for investigating the structures of large molecules such as proteins.
- Historically, many practically useful ideas in science were first developed by scientists who were simply exercising their curiosity, for example, Faraday's electric motor and his means of generating electricity from moving magnets.

A vital part of the LHC project is the Grid, an international cutting-edge computing resource that enables the processing of massive quantities of data from the LHC detectors

There are two main target audiences for this message: the general public and policy makers and opinion formers. More detailed messages for *both* audiences:

- Like the Internet, the Grid facilitates many big science projects that require access to powerful computing resources, not just the LHC.
- The Grid is already benefiting society, through drug discovery and biomedical

research. As Grid technology develops, it may, like the World Wide Web, eventually find its way into homes and work environments.

- The development of the Grid involves thousands of people from dozens of countries working together, with the UK taking one of the leading roles.

More detailed messages specific to policy makers and opinion formers:

- The UK's participation in Grid projects is essential for UK academics to stay among the leaders in a wide range of science areas
- The UK is one of the main players in this IT revolution, as a result of the Government's pioneering investment in e-Science across many disciplines.
- This is a vital technology for the future of globally distributed computing, and British industry is benefiting from the investments made to date.
- Grid projects have trained experts in this cutting-edge area of IT, who are distributing this knowledge to the wider IT community.

The scientists involved are keen that the public, which has made possible this facility, share the excitement and value of this work

- CERN's costs are mainly shared mainly by its twenty Member States, with significant contributions from Observer nations
- The public has ready access to information about LHC from high-quality web sites and from the many public events attended by scientists, who both talk and listen.
- CERN hosts large numbers of school student and members of the public on organized visits.

Young people, from every background and with many different talents, can be part of scientific activities like this if they study physics

- The branch of science addressed in LHC is particle physics, the study of the fundamental things that make up the universe and the laws that govern how they behave
- Anyone with sufficient ability and enthusiasm can contribute to this field: you don't have to be a genius

- Young people make many of the most powerful creative contributions to science— it is a myth that brilliant scientists are usually old white men.
- People with many different talents are needed to make the LHC a success: experimental and theoretical physicists, engineers, project managers, materials scientists, and so on
- Anyone can enjoy this science but to participate in it, you have to study physics and closely related subjects

British industry benefits from this project, and can benefit further from future projects in particle physics

- British companies have made several crucial contributions to the building of the LHC and its detectors, including precision high-tech engineering, electronic and magnetic components and state-of-the-art vacuum technology

At reasonable cost, the project will tell us fundamental things about the way the universe works

- The total cost to the UK taxpayer of the LHC is £344 million, spread over about ten years. That's an average of £34 million per annum
- This is less than the cost of a pint of beer or a modest glass of wine for every adult in the UK each year
- CERN's annual budget is about the same as that of Geneva's main hospital, i.e. a major city hospital
- The entire LHC project will cost about the same as one week of the world's budget on advertising ('The Economist' estimates this budget to be \$1bn per day).

Regarding the final general point, at least three comparators are needed that will stand scrutiny on the 'Today' programme. The examples should refer to, for example, government expenditure on health and well-being, other branches of research, and something relatively frivolous like spending on the Lottery or on liquor. Another example is the annual expenditure in the UK on bird food: £220 million.

We also need to have to hand the most powerful quotes. One is the remark made by Robert Wilson in 1969 when he was testifying before the Congressional Joint Committee on Atomic Energy and Senator John Pastore demanded to know how a multimillion-dollar particle accelerator improved the security of the country. Wilson said the accelerator had "nothing at all" to do with security, "it has only to do with the respect with which we regard one another, the dignity of men (sic), our love of culture. It has to do with: Are we good painters, good sculptors, great poets? I mean all the things we really venerate in our country and are patriotic about. It has nothing to do directly with defending our country except to make it worth defending."

Another great quote is from Einstein in the closing weeks of his life: "One thing I have learned in a long life: that all our science, measured against reality, is primitive and childlike-and yet it is the most precious thing we have."