Physicist Ken Peach, recently appointed director of the UK's John Adams Institute, discusses the current state of particle physics in Britain—including a significant change in mood among particle physicists.

Turning Point

The beginning of a new phase in my career is a good opportunity to look back over my past seven years as director of particle physics at the Rutherford Appleton Laboratory (RAL) and to look forward to my next few years as director of the John Adams Institute for Accelerator Science.

In 1998, the Large Electron Positron Collider (LEP) at CERN and the Stanford Linear Collider (SLC) at SLAC were running but had not seen any hint of a Higgs boson. The Tevatron collider at Fermilab and the HERA collider at DESY were still in their "Run One" phases; SNO—the Sudbury Neutrino Observatory—stood (according to their internal joke) for "Still Not Operating"; the *B*-factories were in their final stages of construction; and construction had begun for the Large Hadron Collider (LHC) at CERN and Fermilab's NuMI/MINOS neutrino physics project. Now, LEP and SLC have finished running; we are still hunting the Higgs; the Tevatron and HERA are both midstream in "Run Two"; the Sudbury Neutrino Observatory and the *B*-factories have exceeded all expectations; NuMI/MINOS is beginning to take data; and the LHC machine and detectors are well into installation.

Particle physicists in the United Kingdom have been very active in all these experiments and in others (rare kaon physics, searches for electric dipole moments, proton decay, and dark matter) throughout these years. To an observer, it might look like "business as usual," but in fact this period has been characterized by a very significant change in mood.

Renewed optimism comes from increased emphasis on science by the UK government. The nation's science budget has almost doubled over this time, and the government is committed to doubling the budget again over the next 10 years. This increase in resources has not only led to a significant increase in the amount of science research in the United Kingdom, but—more importantly—has addressed the serious issue of research infrastructure: world-class science needs world-class laboratories.

It is against this background that the fortunes (perhaps an unfortunate choice of word) of particle physics in the United Kingdom must be judged. And the judgment must be that particle physics has really done rather well. Over these past seven years, for example, the Particle Physics and Astronomy Research Council (PPARC), which funds all particle physics research in the United Kingdom (including the CERN subscription), has approved major new UK commitments to the experiments ATLAS, CMS, and LHCb at CERN and to CDF and DZero at Fermilab, as well as initiating the Linear Collider Flavour Identification (LCFI) project to investigate vertex detector technology for the International Linear Collider.

Besides the investment in experiments, we have seen a corresponding investment in phenomenology and theory in the universities. The creation of the Institute for Particle Physics Phenomenology (IPPP) in Durham has energized phenomenology in the United Kingdom and spurred growth at other universities including Southampton and Edinburgh. Investment in high-performance computing has kept the UK Quantum Chromodynamics (UKQCD) collaboration competitive in lattice field theory calculations. String theory continues to attract the brightest stars, sometimes to the bafflement of those of us less brilliant.

I have tried—so far with success—to avoid the words "spending review," but can postpone no longer. Since 1998, there has been a more or less "continuing revolution" in all public institutions in the United Kingdom. Each July, in even years, the government announces a new spending review, setting out the budgets and priorities across the whole of government expenditure (including science) for the following three years, with the first of these three years overlapping with the last year of the previous review. In odd years, the task is to work out how best to spend the resources from the previous review, and to prepare bids to attract new resources in the following review. It might sound a bit odd, but it combines the need for stability in planning with the need to adapt plans to circumstances.

The spending review process has been very good for science. It provides the opportunity for specific initiatives with specially allocated funding. Two such initiatives have had enormous impact on particle physics. The first is the "e-Science" program, which encompasses the data grid but addresses a much wider agenda. It began in the spending review in 2000, continued in 2002, and was absorbed into the baseline

in 2004. Each of the eight Research Councils (including the newly created Arts and Humanities Research Council) has an e-Science program, and there is no doubt of its global impact. Not only has the program placed the United Kingdom among the leaders in the development of the computing infrastructure of the future, but it has stimulated similar programs in many other countries. The GridPP project is the United Kingdom's contribution to the development of the particle physics computing grid, essential if we are to provide sufficient computing power for the LHC data deluge.

The second initiative is in accelerator science, which again has an impact beyond particle physics. In 1998, there was essentially no accelerator R&D in the United Kingdom *for particle physics.* Accelerator R&D was devoted to spallation neutron sources, to the ISIS pulsed neutron and muon source at RAL, and to the Synchrotron Radiation Source at Daresbury. Now, following recent spending reviews, we have strong programs in both linear collider and neutrino factory R&D in universities and in the Council for the Central Laboratory of the Research Councils' (CCLRC's) Accelerator Science and Technology Centre (ASTeC), created in 2001, as well as enhanced R&D programs for neutron and photon sources. We have seen the birth of two accelerator science institutes, the Cockcroft Institute at Daresbury with the Universities of Lancaster, Liverpool, and Manchester; and the John Adams Institute with the University of Oxford and Royal Holloway, University of London.

Finally, we now have a mechanism for funding very large projects, the Large Capital Facilities program, with its own road map. Already, particle physics in the United Kingdom—and worldwide—has benefited. From this source has come £7.5M (US$13.5M) of the £9.7M (US$17.5M) for the construction of the first phase of the Muon Ionisation Cooling Experiment (MICE) on ISIS at RAL—the first accelerator project for particle physics hosted in the UK in more than 25 years.

Of course, there is more that we could do and would like to do. We still grumble that there is not enough to go round—because there is not enough to go round. But at least in the United Kingdom the gap between our ambitions and reality is much smaller than it used to be. It is perhaps significant that the organization called "Save British Science" has just changed its name to the "Campaign for Science and Engineering in the UK."

Ken Peach

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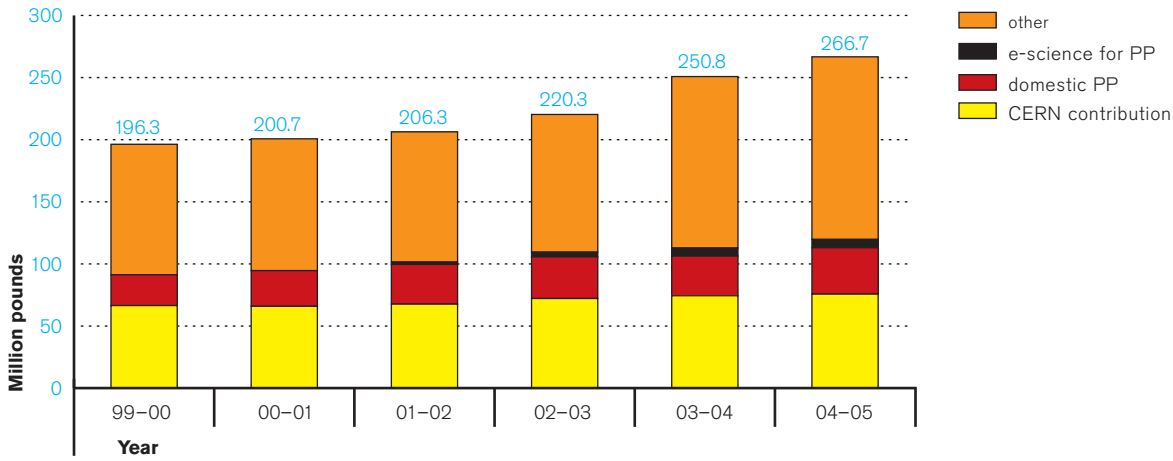
PPARC budget numbers



The Particle Physics and Astronomy Research Council (PPARC) manages the funding for research, education, and training in particle physics and astronomy in the United Kingdom. Over the last six years, the total PPARC budget has increased from £196.3M to £266.7M (£1 = US$1.88, May 2005). The funding for particle physics has risen from £91.3M to £119.7M. It includes the UK contributions to CERN, the domestic spending on particle physics and the new e-Science for particle physics program, which includes money for LHC computing projects.