NEWS AND ANALYSIS

People, particles and purse-strings

Lyn Evans has one goal – to build the world's biggest and most powerful particle accelerator by the summer of 2007. **Matin Durrani** finds out how he manages a project of such size

Scientific projects do not get much bigger or more daunting than the Large Hadron Collider (LHC) at the CERN particle-physics lab near Geneva. Housed in a 27 km long circular tunnel, the LHC will collide beams of protons at energies of up to 14 000 GeV. The protons will be steered round by over 1200 superconducting dipole magnets, each generating a field of 8.3 T. An incredible 50 000 tonnes of hardware – beam pipes, cables, cladding and coils – will have to be cooled to less than 2K using liquid helium to make the magnets superconduct.

The SwFr 4.5bn (about €2.9bn) machine will be used to search for the elusive Higgs boson, which is believed to provide all other particles with mass. Physicists also hope to use the LHC to detect evidence for supersymmetry, which would help theorists to unify quantum mechanics and gravity. Other projects include studying quark-gluon plasmas, probing the difference between matter and antimatter, and measuring the mass of the W boson and the top quark with high precision.

With such huge scientific hopes pinned on the collider, it is surprising that the man masterminding construction of the LHC is so calm. Lyn Evans – a 58-year-old Welshman – is an old CERN hand, having joined the lab in 1969 after completing a PhD in plasma physics at the University of Wales, Swansea. His first job at CERN involved analysing the “duoplasmatron ion source” that fed protons into the Proton Synchrotron – the lab's main accelerator at the time.

After briefly working on an experimental linear accelerator, Evans became one of the first 50 people recruited by the then CERN boss John Adams in 1971 to build the lab's next big machine – the Super Proton Synchrotron (SPS). In the late 1970s he joined the team that converted the SPS into a proton-antiproton collider. The SPS was responsible for one of CERN's greatest moments – the discovery of the W and Z bosons in 1983 (*Physics World* January 2003 pp23–28).

Changing roles

After further rises up the CERN ranks, Evans was appointed project leader of the LHC in December 1994 when the collider was approved by CERN council. Over the years his role has changed as the project has evolved. He initially acted as a design physicist, working alongside engineers to optimize the machine's performance. Later he became a globe-trotting politician and diplomat, persuading international collaborators to join the project. When construction

Machine supremo – Lyn Evans.

finally began in 2001, commercial issues began to occupy much more of his time. Indeed Evans is now something of an expert in insolvency law, having suffered at the hands of contractors who have suddenly gone bust.

One of Evans' biggest challenges is to ensure that the project remains on schedule. Following CERN's budget crisis two years ago, when it was revealed that the LHC would cost 30% more than expected (*Physics World* November 2001 p7), Evans persuaded the lab to introduce a radical new way of monitoring costs. Known as “earned value management”, it involves breaking down the entire construction project into 10 000 separate “work packages”. Groups have to report at weekly intervals what fraction of the work has been finished, known as the “earned value”. Conventional project-management techniques, in contrast, simply track the amount of money that has been spent.

The advantage of the new approach is that it gives a more accurate picture of whether the project is on time and can distinguish between delays and cost overruns. According to the latest figures, the LHC is currently running about SwFr 100m below the planned budget. “What the new system is telling us is that the shortfall is due to various delays in equipment delivery,” explains Evans. “We have not drawn the false conclusion that we are saving money. Fortunately, not all equipment is on the critical path, which means that the delays are not affecting the overall schedule of the project.”

Evans had to press hard to introduce the system. Experienced CERN engineers, who had built other accelerators without it, initially could not see why they needed the additional bureaucracy. Perversely, Evans was helped by the pressure of the budget

crisis, which forced CERN to review how it controls its spending. “In previous projects we had more slack in the system to allow for adjustments or overspends, and there was also less expectancy from the outside,” he says. “We took advantage of the crisis to make serious reforms to our project management. Without the crisis, we would not have succeeded.”

Evans has also had to cope with changes to CERN's management structure. In the past, accelerators at CERN were built by a single, dedicated team of scientists and engineers. Now, however, there is a “matrix” structure, in which construction of the LHC is split between 600 staff in various divisions – such as accelerator technology, accelerator beams and technical services – who also have to run and maintain CERN's existing machines. Evans also has to provide the infrastructure for the detectors, such as electricity, cooling and ventilation, although he is not responsible for the LHC's experiments, which are built by international collaborations.

Champagne moments

So what does it take to be a project leader? “One of the most important skills is to have respect in the international community as an accelerator physicist,” says Evans. “People have to be sure you know what you are doing. I also need people-management skills, especially to work in a matrix structure, which is notoriously difficult. You cannot do it by dogma. You cannot have an imposed hierarchy.”

Although commissioning of the machine is still over three years away, things are starting to hot up. When the LHC is complete, beams of protons will be injected into it from the SPS, and last month Evans managed to create a 450 GeV beam of the required quality in the SPS. In autumn 2004 the SPS beam will then be led to the point where it is injected into the LHC. The next milestone will be in the spring of 2006, when Evans hopes to send the beam round one arc of the LHC. “But the big champagne moment will be when we get our first collisions in summer 2007,” he says.

Evans is philosophical about the challenges ahead. “As in any project, there are ups and downs. You make the most of the ups and learn to deal with the downs. In an ideal world all contracts would run to perfection and there would be no hiccups or late deliveries. But life is not like that – building an accelerator is not a mathematical exercise. Nevertheless, there has been steady progress and we now have the end in sight.”