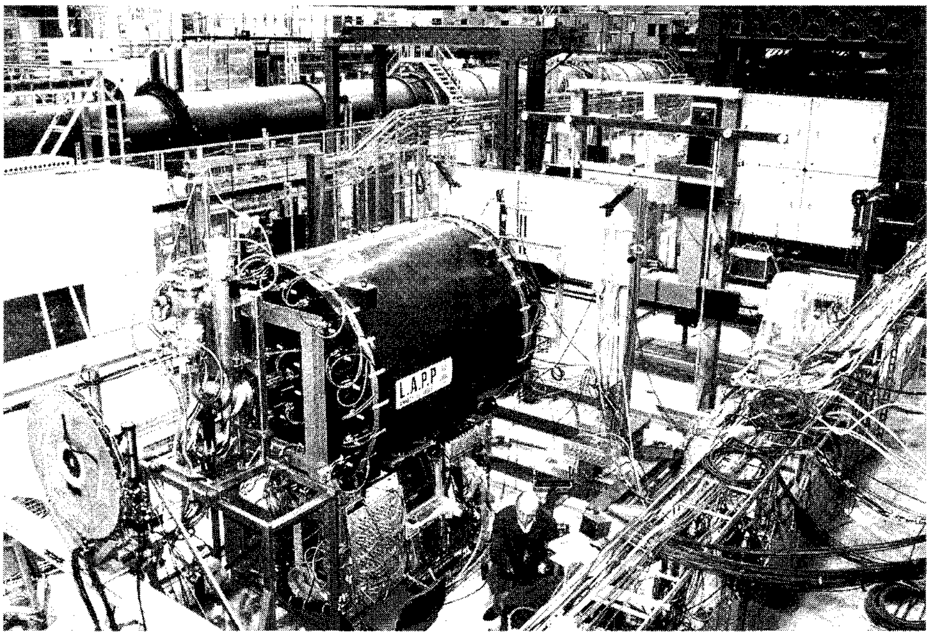
Around the Laboratories

CERN
Fixed target targets

While the immediate priority of CERN's research programme is to exploit to the full the world's largest accelerator, the LEP electron-positron collider and its concomitant LEP200 energy upgrade (January, page 1), CERN is also mindful of its long tradition of diversified research.

Away from LEP and preparations for the LHC proton-proton collider to be built above LEP in the same 27-kilometre tunnel, CERN is also preparing for a new generation of heavy ion experiments using a new source, providing heavier ions (April 1992, page 8), with first physics expected next year. CERN's smallest accelerator, the LEAR Low Energy Antiproton Ring continues to cover a wide range of research topics, and saw a record number of hours of operation in 1992. The new ISOLDE on-line isotope separator was inaugurated last year (July, page 5) and physics is already underway.

The remaining effort concentrates around fixed target experiments at the SPS synchrotron, which formed the main thrust of CERN's research during the late 1970s. With the SPS and LEAR now approaching middle age, their research future was extensively studied last year. Broadly, a vigorous SPS programme looks assured until at least the end of 1995. Decisions for the longer term future of the West Experimental Area of the SPS will have to take into account the heavy demand for test beams from work towards experiments at big colliders, both at CERN and elsewhere. The North Experimental Area is the scene of larger experiments with longer lead times.


The GAMS experiment took final data at CERN last year. An Annecy (LAPP)/KEK (Japan)/Los Alamos/Pisa/Serpukhov collaboration, it is one of the long standing examples of Russian collaboration at CERN. The GAMS acronym stems from the Russian abbreviation for the experiment's large lead-glass arrays, seen in the background.
(Photo CERN 22.4.1991)

Several more years of LEAR exploitation are already in the pipeline, but for the longer term, the ambitious Superlear project for a superconducting ring (January 1992, page 7) did not catch on.

Neutrino physics has a long tradition at CERN, and this continues with the preparations for two major projects, the Chorus and Nomad experiments (November 1991, page 7), to start next year in the West Area. Delicate neutrino oscillation effects could become visible for the first time, and help explain the continuing dilemma of the dearth of solar neutrinos (December 1992, page 12).

For the longer term future, a larger detector could provide an increased yield, boosting the neutrino capture rate by up to a factor of ten. Other, more spectacular, option is to shine the CERN neutrino beam towards a detector a long way off. Such a beam is practically unimpeded by matter and could pass right through the earth. Possible contenders for underground target stations equipped with big detectors are the Italian Gran Sasso laboratory, 730 kilometres south, or Superkamiokande, 8750 kilometres away in Japan.

Other major ongoing 'flagship' SPS projects include the NA48 experiment to continue precision measurements on the still unexplained phenomenon of CP violation (March 1992, page 7) and the 'Spin Muon Collaboration' looking to probe the spin structure of the proton and the neutron using high energy muon beams (April 1992, page 21). Both these experiments address important physics issues. While SMC is already taking data, NA48 will not become operational until 1995, but should run then for more than three years.

Elsewhere at the SPS, ongoing studies include a programme using hyperon beams, and a study of beauty particles (WA92) which would be hampered once the new neutrino programme starts. The spectroscopy of particles containing light quarks, although far from having solved all outstanding questions, is slowly coming to the end of its SPS career. The WA91 glueball search at the big

Omega detector will continue taking data in1994. The GAMS experiment took its final CERN data last year. One of the long-standing examples of CERN-Russian collaboration, GAMS earned its acronym from the Russian abbreviation for its characteristic large lead-glass arrays. GAMS experiments have run both at CERN and at Serpukhov's Institute for High Energy Physics near Moscow.

CORNELL Synchrotron 25

Cornell notables (left to right) Robert Wilson, Boyce McDaniel, Maury Tigner and Karl Berkelman at the 25th anniversary celebrations of Cornell's electron synchrotron.

A recent celebration marked the twenty-fifth anniversary of the Cornell Electron Synchrotron. The major milestone in the commissioning of the synchrotron was on October 11, 1967 when Helen Edwards, Boyce McDaniel, and Maury Tigner achieved a 7 GeV beam, a world-record energy for electron synchrotrons at that time. Like so many advances in experimental physics, this occurred early in the morning - 3 a.m.!

The transition from accelerator commissioning to high energy physics operation was extremely rapid; 7 GeV operation for data collection was routine just five weeks later. Throughout its life as a source of photon and electron beams for fixed target experiments, the synchrotron maintained energy leadership for circular electron machines. Originally designed for operation at 10 GeV, eventually it consistently provided beams for experiments at energies up to 11.6 GeV. It now operates at 5 GeV, serving as the injector for the CESR electron-positron storage ring.

Robert Wilson was director of the laboratory during the design and most of the construction of the machine. He left near the end of the construction to become the first director of Fermilab and was replaced by Boyce McDaniel, who guided the laboratory from the completion of the synchrotron to the construction and early operation of CESR.

Wilson recalled how the laboratory had originally proposed a 3 GeV turnkey machine to be built entirely by industry and would fit in the space previously occupied by earlier Cornell accelerators. However, members of the laboratory realized that 3 GeV would not open new physics frontiers, that the construction of the accelerator was much of the fun of doing high energy physics experiments, and that a more challenging project was needed. This led to the proposal for the 10 GeV synchrotron which was built in the "Cornell Style" with many of the components fabricated and nearly all of the assembly done at Cornell.

The Cornell synchrotron introduced a number of innovations in accelerator design and construction to keep the cost down. To reduce the radiofrequency power required to replace energy lost through synchrotron radiation, the circumference chosen (757 m) was significantly larger than that of other electron synchrotrons of that era. This choice turned out to be particularly fortunate because this tunnel size is excellent for an electron-positron storage ring operating in the region of the upsilon resonances and the threshold for B meson production. From the beginning a storage ring in the tunnel was envisioned as an eventual upgrade, although nobody had any idea what the most interesting energy region would be.

The synchrotron is located 16 m under Cornell's athletic fields. The depth of the tunnel and the continual use of the playing fields meant that standard cut-and-fill techniques for digging the tunnel were impractical. This led to the use of a tunnel boring machine, the first time that this technique was utilized in construction of a synchrotron tunnel.