

Installing the CLEO II detector at Cornell's CESR electron-positron storage ring.

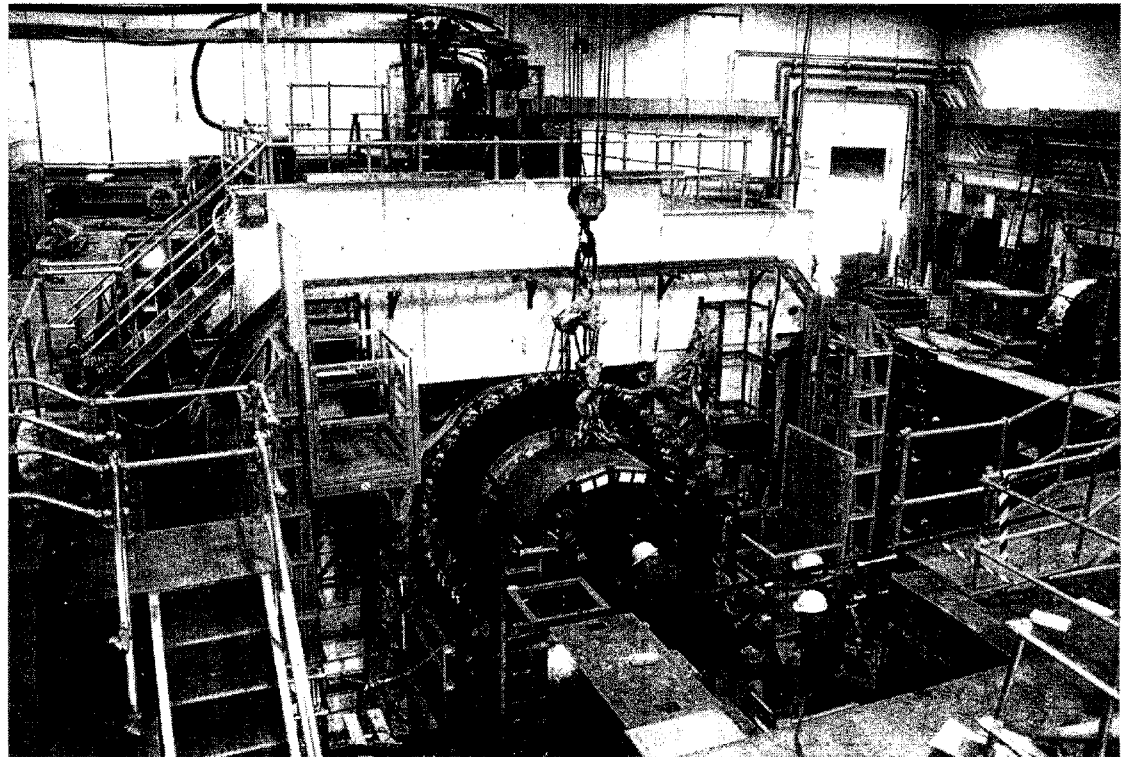
CORNELL B physics

Good news from the National Science Foundation assuring future B physics productivity at Cornell's CESR electron-positron collider and the CLEO detector followed almost immediately after the US Department of Energy's announcement that SLAC (Stanford) had been selected as the site for the proposed US asymmetric B Factory, as a part of a package of federal projects for California (see page 2).

(The proposed factory schemes envisaged colliding electron and positron beams of different energies, hence the adjective asymmetric. Normally electron-positron colliders have equal energy - symmetric - beams.)

In parallel with the B Factory idea, CESR and CLEO have for several years been pursuing a staged up-grade programme for improved symmetric-energy collider operation through the 1990s and beyond. Phase I of the programme, recently completed, had the goal of increasing the peak luminosity of the ring to exceed $2 \times 10^{32} \text{ cm}^{-2} \text{ sec}^{-1}$ (currently 2.5×10^{32}) and increasing the data rate capabilities of the CLEO detector to match.

Phase II, now underway, involves a doubling or tripling of the CESR luminosity by storing larger beams. The scheme for increasing beam current is based on an idea by Cornell accelerator physicist Robert Meller. Presently, the two beams circulate in separate "pretzel" orbits that weave around each other so that seven beam bunches can be stored in each beam without colliding with those in the other beam except at the experiment (October 1992, page 17).



In Meller's scheme the pretzel orbits cross at a 2 milliradian angle instead of intersecting head on, as in existing electron-positron rings. This allows one to replace each beam bunch by a train of closely spaced bunches, increasing the frequency of bunch-bunch collisions. Tests at CESR have verified that the luminosity per bunch-bunch collision is negligibly affected by the small crossing angle.

As a part of the Phase II upgrade, the CLEO detector will be adding a three-layer, double-sided silicon vertex detector to improve the identification of charmed particles and reduce the background in the reconstruction of B decays. Installation of the Phase II CESR and CLEO equipment will be completed next year.

Details of Phase III have been worked out during the past year. This is a more ambitious and costly scheme to further double or triple the CESR luminosity, taking advantage of the crossing angle orbits to store even more bunches per train. The resulting circulating currents, in the

ampere range, will require new superconducting radiofrequency cavities of the kind proposed and prototyped (December 1992, page 16) for the B Factory, as well as extensive vacuum system modifications. The goal is a peak luminosity of at least 10^{33} , and perhaps higher. Phase III also involves rebuilding the inner tracking and hadron identification components of CLEO to increase significantly its performance in measuring rare B meson decays and other low rate processes.

In October the National Science Foundation approved a five-year operations and upgrade programme which should lead to completion of Phase III. This assures the continued productivity of CESR/CLEO at the forefront of B physics into the next century.

Thanks to the record luminosity of the CESR collider, CLEO has recently become sensitive to one-loop weak decays with the discovery of the first "penguin" decays (June, page 1). Rates for such exotic processes depend on the presence

One of the major achievements of the KARMEN experiment by a German/UK collaboration at the Rutherford Appleton Laboratory ISIS source has been the first observation of a neutral current excitation of a nucleus.
The neutral current excitation of carbon-12

shows up as a clear peak around 15 MeV in the energy spectrum of neutrino-induced reactions in the muon decay time window. The broad bump structure is due to charged current reactions to the ground state as well as to excited levels of nitrogen-12.

of intermediate heavy particles, invisible but still playing a role - the top quark, the W boson, and perhaps exotic objects like Higgs bosons or supersymmetric partners.

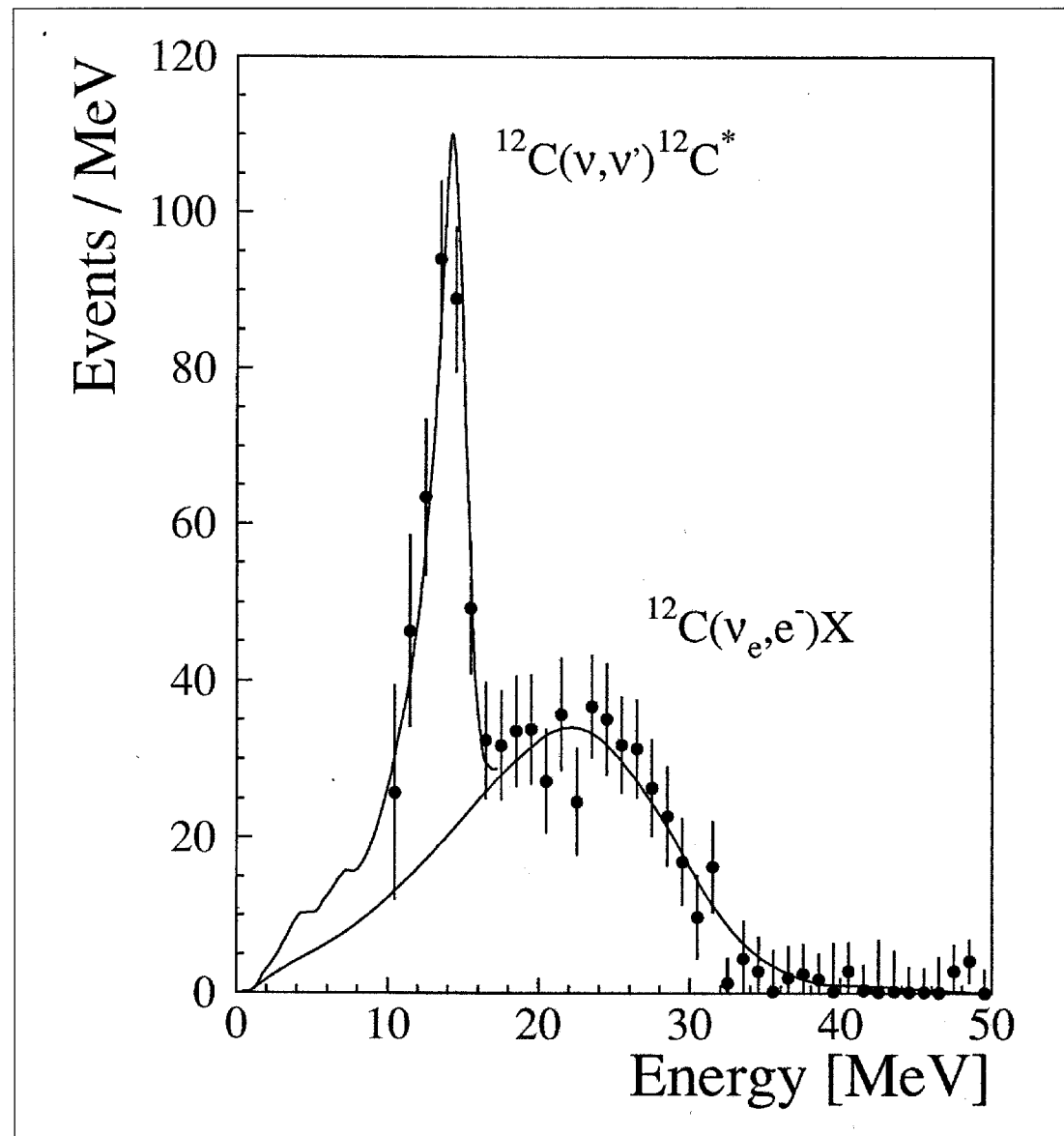
Continued CERN progress and detector performance will open up a new window on physics beyond the Standard Model. There are also exciting opportunities in the study of the tau lepton and charmed hadrons.

A symmetric energy CERN will likely have produced more than 60 million Bs even before an asymmetric B Factory could be near its design goals, and will still be an effective competitor afterward.

KfK KARLSRUHE/ RUTHERFORD APPLETON New neutrino physics

The Karlsruhe-Rutherford Medium Energy Neutrino Experiment (KARMEN) at the UK Rutherford Appleton Laboratory's ISIS spallation neutron facility studies the interactions of neutrinos with nuclei in an energy range of particular importance for neutrino astrophysics.

After its first three years of data-taking the German/British experiment has analysed more than 1000 neutrino-nucleus interactions. The spectroscopic quality of neutrino data complemented by an extremely low background allows reliable cross-section measurements down to 10^{-42} cm^2 as well as precision tests of the standard model.



Having reached its design value of 200 microamps average proton beam current at 800 MeV, ISIS is the world's most powerful pulsed medium energy neutrino source. The proton beam stop delivers extremely short but intense bursts of neutrinos. A prompt burst of 30 MeV muon neutrinos from pion decay at rest is followed by a pulse of electron and muon antineutrinos from muon decay at rest with energies up to 53 MeV. This allows separation of different neutrino 'flavours' by time measurement. In addition, cosmic ray background is highly suppressed.

Neutrinos are detected by a 60 ton

high resolution liquid scintillation calorimeter 17.5 m from the beam stop and housed in a massive 6000 ton iron blockhouse. Consisting entirely of hydrocarbons, the calorimeter is an all active target of carbon-12 and hydrogen nuclei. Nuclear excitations by neutrino interactions with carbon-12 nuclei through weak charged or neutral currents can be identified by the subsequent deexcitation processes.

At beam stop energies nuclear charged current reactions can only be induced by electron neutrinos. A prototype example is the charged current transition from carbon-12 to