

## Beauty...

B-physics - the study of particles containing the fifth (beauty, or 'b') quark - is at a turning point. After the discovery of this quark at a proton machine - Fermilab - in 1977, most of our knowledge of its physics subsequently has come from experiments at electron-positron colliding beam machines.

Although this tradition is continuing with the latest results emerging from the upgraded CLEO detector at Cornell (June 1993, page 1) and from the major B contributions of the LEP experiments at CERN, experiments at hadron colliders have begun to produce complementary results.

First, the UA1 experiment at CERN's proton-antiproton collider saw the oscillation between different neutral B-mesons. Subsequently UA1 saw evidence for B-baryons (December 1991, page 29). Now, the CDF experiment at Fermilab's Tevatron collider has demonstrated that very clean samples of exclusive B-meson final states can routinely be obtained at hadron colliders and, using a silicon microvertex detector, has shown that B-meson lifetimes can be well measured. An ever-increasing flow of new B-physics is expected from CDF in the near future.

The First International Workshop on B-Physics at Hadron Machines, Beauty '93, held earlier this year at Liblice Castle, near Prague, in the new Czech Republic, reflected this trend. Representatives from most existing and proposed B-physics enterprises attended, providing a forum for detailed comparisons of all proposed methods of B experimentation.

In the next generation of B experiments, the search for CP violation -



the breakdown of the conservation of combined particle-antiparticle and left-right substitution - will figure prominently. Although CP violation has been known for almost 30 years in the decay of K-mesons, its discovery and study in the decay of B-mesons is a contemporary physics goal of the highest rank, because it will probe deep into the standard model and may lead to new physics beyond. However, because the effects of CP violation in B-decay are only seen in rare decays, its study will require a lot of data.

While electron-positron collider B-factories, with their unique and well understood environment, will continue to play an important role in the future of B physics, it is crucial that experiments at hadron machines, with their much larger B yields, also be pushed.

For example, proton-proton collisions at the future Large Hadron Collider (LHC) at CERN will produce at least 7000 times more B-mesons per second than will electron-positron

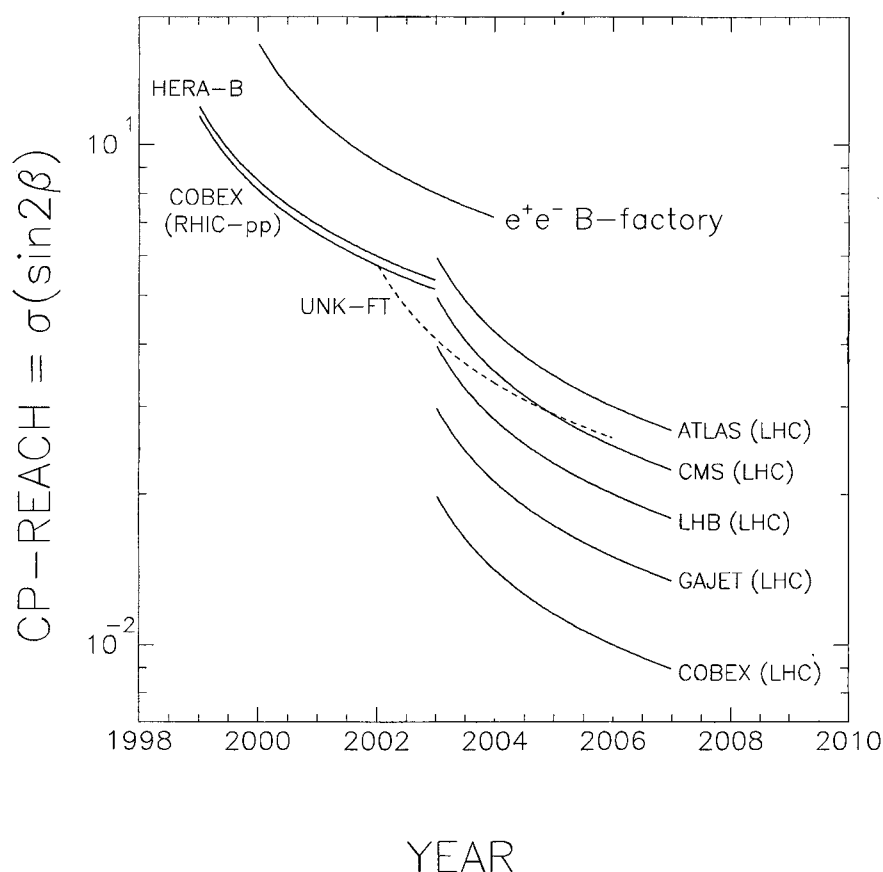
collisions at a B-factory. Although the overall efficiency for using hadronic events to study CP violation is about 100 times smaller (due to a variety of reasons) a net improvement factor of about 70 remains.

At the workshop, the full range of possibilities for B-physics at hadron machines was discussed. Many simulation studies and much specialized detector R&D work have been carried out during the last few years.

Looking forward to this next generation of hadronic B-physics, there were three talks on CP violation studies with the general purpose detectors proposed for CERN's LHC. P. Eerola (CERN) presented prospects of the ATLAS detector, N. Neumeister (Vienna) discussed the CMS detector and D. Denegri discussed the L3P detector.

The prospects for dedicated B experiments at proton machines were discussed in a series of five presentations. P. Schlein (UCLA) talked about the COBEX open geometry forward collider detector

*CP reach - expected progress in measuring the CP-violation parameter for different proposed experiments measuring 'gold-plated' B decays to J/psi and a short-lived kaon (in most experiments, the uncertainty can be reduced by about a factor of 0.6 by combining data from several final states). The curve for COBEX at Brookhaven's RHIC 'heavy ion' collider assumes proton-proton running for half the time.*



being proposed for LHC. F. Costantini (Pisa) described LHB, a fixed target B experiment being proposed for LHC which would use an external proton beam obtained with crystal extraction. Y. Lemoigne (Saclay) discussed the GAJET proposal, which would use a gas-jet target in the circulating LHC proton beam.

(This LHC B physics potential was examined in a special LHC workshop in May - see page 2.)

S. Conetti (Virginia) described recent experiences of fixed-target experiment E771 at the Tevatron and the prospects for the proposed SFT experiment in a 20 TeV crystal-

extracted beam at the US SSC. W. Hofmann (MPI-Heidelberg) considered the use of a configuration of internal wire targets positioned in the halo of the circulating HERA proton beam at DESY, with B decays detected in a forward spectrometer.

There were three talks on the UNK accelerator project at the Institute for High Energy Physics at Protvino in Russia. A. Zaitsev (Protvino) reviewed the diversity of the entire 3 TeV fixed target programme.

V. Gurov looked at the design and operation of the asymmetric UNK collider as a proton-proton collider B-factory, and A. Zlobin (Protvino) summarized superconducting mag-

net development for the 3 TeV ring.

With the disruption of science in the former Soviet Union by the events of the past few years, there was some discussion of possible political and financial mechanisms for underwriting the completion of the UNK project.

The meeting closed with reports from five working groups: one on theoretical questions connected with the physics of beauty-charm states (convener: G. Nardulli, Bari), one on the problems of studying the rare and difficult decay of B-mesons into two pions (convener: S. Erhan - UCLA), one on some general questions of detector design (convener: M. Medinnis - UCLA), and one on problems of triggering and data acquisition common to all optimized B experiments at hadron machines (convener: J. Zweizig - UCLA).

Finally, there was a report from the "CP-Reach" working group (convener: P. Harrison - QMW, London), making a first attempt to compare all proposed experiments using the same criteria.

There was little doubt at the end of the workshop that B-physics, and in particular CP violation studies, has a bright future at hadron machines. Further developments will be reported at Beauty '94, already in the planning stage.

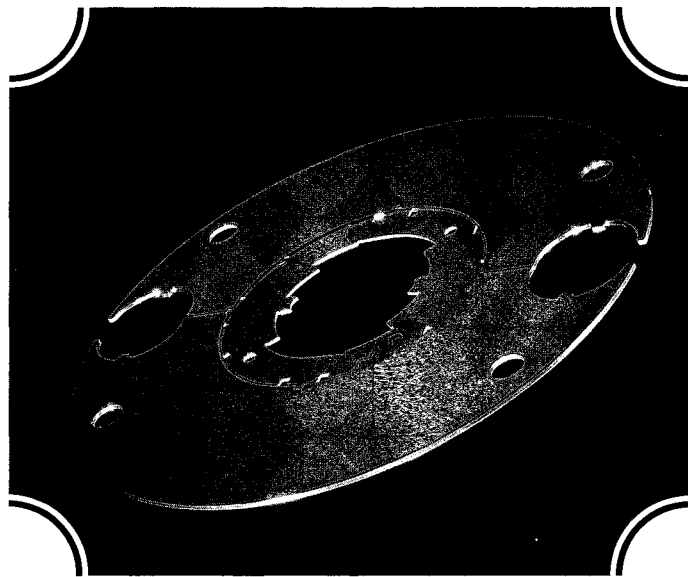
The workshop was supported by The Czech Academy of Sciences, their Institute of Physics in Prague, and INFN-Rome I. The proceedings of the Beauty '93 workshop have recently appeared as a special issue of Nuclear Instruments & Methods, Volume A333, No. 1 (August 1, 1993). There are 19 papers, plus the reports from the five working groups.

*From Peter Schlein (UCLA)*

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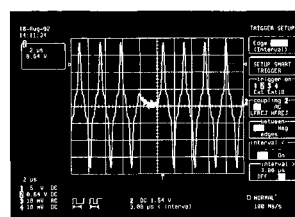
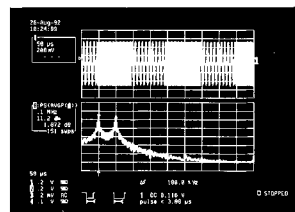
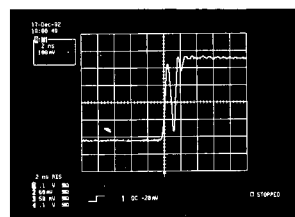
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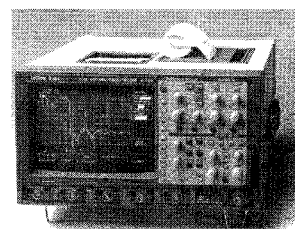
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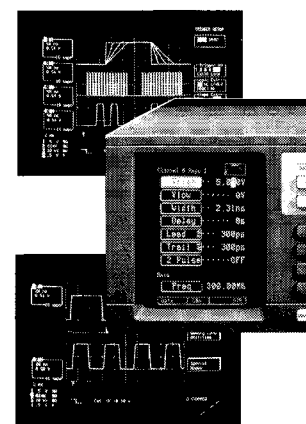
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