

A boost for KAON

Earlier this year, a report by a specially-formed subcommittee of the US Nuclear Science Advisory Committee gave an important boost to the proposal to build a high intensity particle beam 'factory' at the Canadian TRIUMF Laboratory in Vancouver.

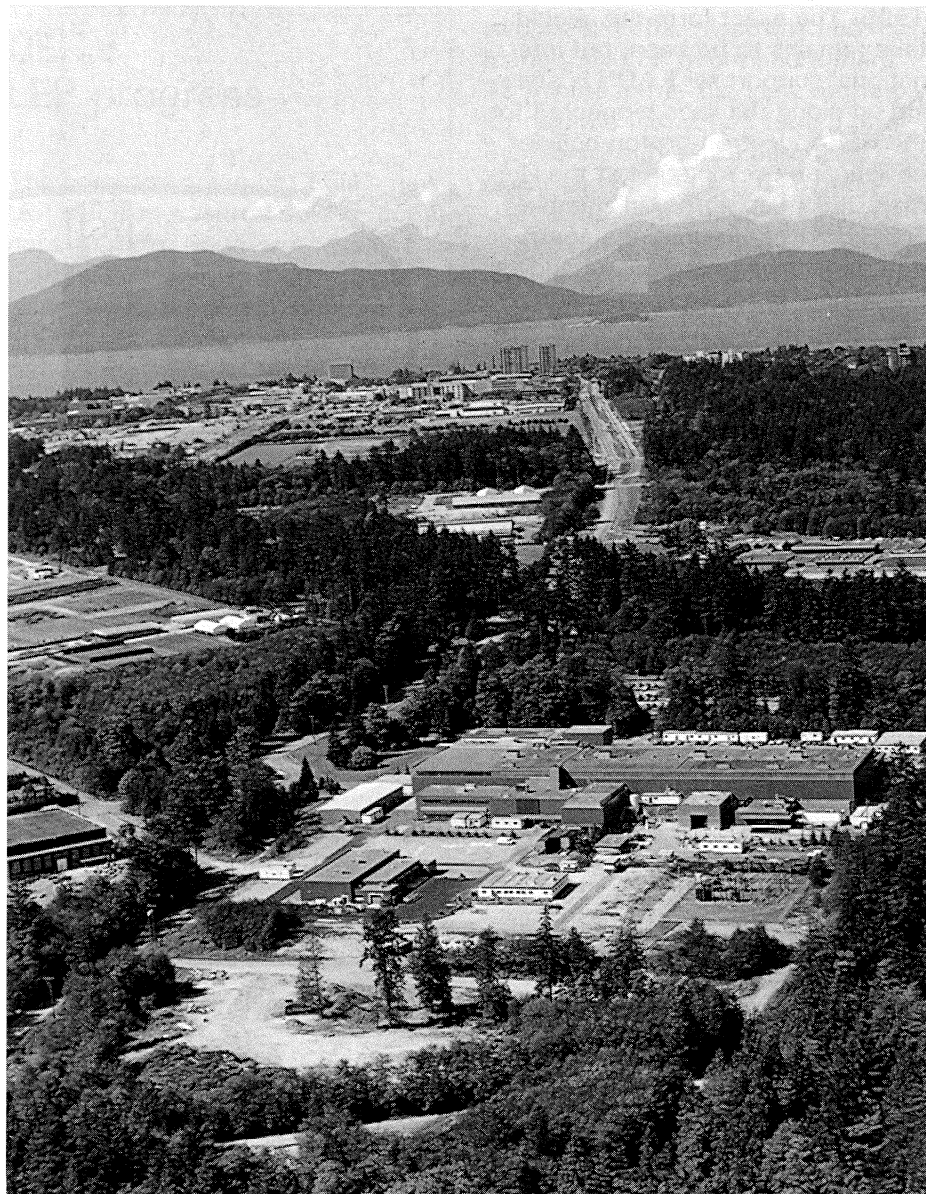
Last year, TRIUMF received a total of 11 million Canadian dollars (September 1988, page 1) from the federal government in Ottawa and from the regional British Columbia administration for a Project Development Study, with a final report expected towards the end of this year. The hope is to have the green light sometime next year. Estimated cost is 571 million Canadian dollars.

In line with current thinking on particle factories to explore a new high precision physics frontier, KAON aims to provide a high intensity (100 microamp) continuous beam of 30 GeV protons for a wide range of secondary beams – hence the acronym KAON (Kaons, Antiprotons, Other particles, Neutrinos).

Using the existing TRIUMF 500 MeV cyclotron as injector, KAON's special requirements for high intensity beams call for particles passing through a series of five rings, alternately d.c. storage rings and fast cycling synchrotrons.

In parallel with the KAON pilot study, high energy physics contacts in the context of the seven-nation 'summit' group encouraged Canada to seek international interest and commitment to the project. The national delegation made the rounds of the capitals last year, one result being the formation of the special US subcommittee, chaired by Herman Feshbach of MIT.

As well as looking at KAON, the Feshbach subcommittee also



Aerial view of the Canadian TRIUMF Laboratory in Vancouver.

looked at other plans for similar physics opportunities at Brookhaven and at Los Alamos. The report said 'the design of the KAON facility was judged to be conservative. There appear to be no major design problems which would seriously impede construction The facility would certainly "provide the needed experimental capability in this area of hadronic physics". The TRIUMF Laboratory would need to

augment its staff'.

The report also underlined KAON's complementarity to other US nuclear physics projects – the CEBAF electron accelerator under construction at Newport News, Virginia, and the projected RHIC heavy ion collider for the vacant tunnel at Brookhaven.

The proposed US contribution is 75 million US dollars over the five-year construction period ending in

1995. The exact form this would take remains to be seen, but international support for KAON is shaping up along the lines pioneered for the HERA electron-proton collider now nearing completion at the German DESY Laboratory in Hamburg. For HERA, partner nations contributed machine components and know-how in return for a share in the scientific programme.

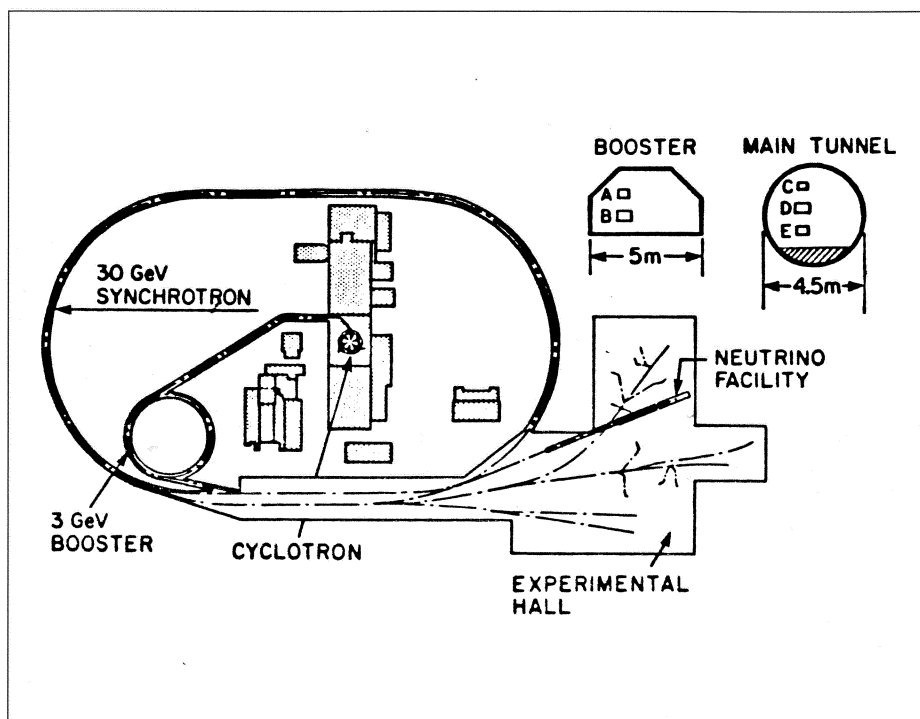
TRIUMF Director Erich Vogt explains that the parallels between KAON and HERA run deeper, with local authorities – British Columbia and Hamburg respectively – playing an important role.

As well as the strong positive reaction from the US, other nations are keen to help KAON get off the ground. Canada was one of the first nations to offer assistance for HERA, and the West Germans could repay the courtesy. Support is not seen as being limited to the seven-nation group and initial contacts have also been made further afield.

The plan is for a third of KAON investment to come from outside Canada, however this would not be reflected in the experimental programme, with two-thirds of the scientists coming from abroad. In the meantime the project is being strongly pushed both by prospective international partners and by the regional British Columbia government, which would provide construction funds.

To help mould the pattern of the scientific programme and to stimulate interest, a series of KAON physics workshops was arranged with venues so far in Canada, Japan, and West Germany. The final meeting (on intense hadron sources and antiproton physics) is in Turin, Italy, in October.

Already this effort has generated widespread user interest and has



A possible layout of the KAON particle factory project at TRIUMF in Vancouver. The 214-metre circumference Accumulator and Booster rings and the 1070-metre circumference Collector, Driver and Extender rings would be housed in two tunnels.

influenced the ongoing design work for the experimental halls, adding requirements for additional beam-lines.

The exacting demands for a particle factory require the existing cyclotron to be supplemented by five rings, labelled A-E, in two tunnels, with the B and D rings running continuous acceleration cycles.

The first of two 214-metre rings is the Accumulator, five times the size of the cyclotron, to take 440 MeV protons obtained by stripping the cyclotron's negative hydrogen ions and stack them over 20 milli-second periods ready for injection into the Booster, a 50 Hz rapid cycling synchrotron taking protons to 3 GeV. Next comes the Collector, the first of three 1070 metre rings, to take five successive Booster pulses and arrange them for the 10 Hz rapid cycling Driver, where the energy is taken to the required 30 GeV level. Finally the Extender stretcher ring optimizes the beam

for slow extraction.

The KAON radiofrequency system has to supply 3MW of beam power with a frequency change as the energy rises from 440 MeV to 30 GeV. By breaking the acceleration into two stages, 440 MeV to 3 GeV in the Booster and the remainder in the Driver, most of the frequency swing happens in the Booster while most of the power is supplied by the Driver. In this way two major radiofrequency tasks are separated.

The existing TRIUMF cyclotron works with negative hydrogen ions, stripped for extraction. For KAON, these ions would need to be extracted before stripping, and the small emittance beam 'painted' over the much larger acceptance of the Accumulator. Negative hydrogen ion extraction from the cyclotron demands some deft radiofrequency manoeuvres, and this work is well in hand.

An initial plan saw five circular

Around the Laboratories

rings, with the largest encircling the present TRIUMF site, but subsequent work showed that improved performance would result if the larger rings were racetrack-shaped. To avoid these rings passing too close to existing buildings, the site could expand across the street.

As part of the preconstruction studies, design teams have looked at some of the demanding problems to be solved, including beam dynamics, magnet design, power supplies, beam kickers, radiofrequency systems, vacuum, etc.

Meanwhile the existing cyclotron continues to provide beams for a wide range of experiments. New ion sources will extend the range of studies possible. Proton-rich isotopes for medical use are manufactured both at the main cyclotron and a smaller dedicated machine. A second such machine is being assembled to boost capacity.

CERN LEP progress

The commissioning of CERN's new LEP electron-positron collider continues to make good progress. As mentioned briefly in the previous issue, by mid-August confidence in the new 27-kilometre ring warranted going for a pilot physics run to give the four big experiments – L3, Aleph, Opal and Delphi – their first taste of collision physics and explore the impressive capabilities of their detection systems.

Late in the evening of Sunday 13 August, only one month after a lone positron beam had circulated for the first time in the ring, just

two weeks after electrons had made their LEP debut and a mere 16 minutes after the start of the pilot run, the first Z had turned up. By midnight three Zs had been seen, and more soon followed.

The run, with collision luminosities of the order of 5×10^{28} per sq cm per s, encountered some technical problems. With 51 Zs in the bag, the run was terminated on 18 August after some 16 hours of physics operation and attention returned to the job of getting Europe's big ring in tip-top shape. One goal is to eliminate some troublesome coupling between vertical and horizontal beam motion. Meticulous machine studies and careful vacuum conditioning continued with the goal of optimizing LEP's

The LEP control room. Seated is Albert Hofmann, who, with Steve Myers, is jointly responsible for commissioning CERN's big new machine.

(Photo CERN 61.8.89)

