

Physics for KAON

Now emerging is a new generation of special purpose machines custom-built for a particular field. An example is the Berlin Compact Synchrotron (COSY) optimized for work with high density semiconductor devices. Similar projects are afoot in the US and Japan.

In the field of ion implantation, originally dominated by classical electrostatic machines, there is a call for higher energies and intensities to probe deeper sample layers. With electrostatic machines in the MeV range being cumbersome and of limited intensity, radiofrequency quadrupoles (RFQs), now being increasingly used as ion injectors in physics Laboratories, could fit the bill. While they are compact and easy to operate, they are more difficult to tune and the initial design requires careful attention.

With high energy physics becoming increasingly dominated by large Laboratories using giant accelerators, the accelerator applications field is moving the other way, towards small, specially-designed machines.

From Oscar Barbalat



Canadian TRIUMF Laboratory Director Erich Vogt – looking for international partners for the KAON project. ►

The KAON high intensity beam factory project at the Canadian TRIUMF Laboratory in Vancouver (October, page 9), continues to receive favourable ratings by US nuclear science advisory groups. Only the CEBAF Continuous Electron Beam Accelerator Facility under construction at Newport News, Virginia, and the RHIC heavy ion collider proposal at Brookhaven are accorded higher priority.

Meanwhile to estimate, stimulate and coordinate physics interest the KAON project team has organized a series of international physics workshops, including one at Bad Honnef in Germany earlier this year.

As well as advertizing the advantages of signing up for KAON, these meetings also reflect some of the problem areas of current physics rarely mentioned in the mass meetings which worship the Standard Model.

Aimed to give future European users an opportunity to shape KAON plans, the Bad Honnef meeting also covered the complementary physics offered at the French Saturne Laboratory at Saclay and the COSY cooler/synchrotron project underway at Jülich in Germany.

Half the talks covered possible strong interaction experimental programmes at KAON, with hadron spectroscopy, where both the theoretical and experimental situations are very unclear, dominating the discussions. The experimental state of affairs was covered in four talks. David Bugg proposed a device to provide full angular coverage of strange baryon resonance production, with better statistics than available bubble chamber data.

Suh-Urk Chung discussed past and future experiments in the mass region of the $\text{iota}/\text{eta}(1450)$. Bill Dunwoodie described the LASS

spectrometer experiment, emphasizing that new spectrometers built for this type of work at KAON must, to avoid kinematical gaps that could result in 'false' states, strive for wide angular coverage.

The theory of hadronic systems was discussed by Frank Close, Stephen Godfrey, Piet Mulders, Fred Myhrer and Josef Speth. The predictions of simple quark-based models are quite successful, however some predicted states are not seen at all while others are seen in the wrong place. Godfrey concluded that a lot more experimental information is needed to decide if a state seen experimentally is a predicted exotic (glueball or hybrid).

KAON would contribute significantly to the physics of hypernuclei (including 'nucleons' carrying strangeness). Bob Chrien discussed kaon production in this context, demonstrating its power for testing models of hypernuclei with recent data from Brookhaven. Peter Barnes proposed an apparatus for the study of light hypernuclei and Stephan Paul described the present muddled status of hypernuclei containing sigma particles, and presented an apparatus to study the problem at KAON.

The long mean free path of positive kaons in nuclear matter has led to expectations of important information on nuclear properties from studies using these particles. Otto Häusser compared this type of experiment to the present nucleon-nucleus program at TRIUMF.

Accelerating polarized (spin oriented) protons to intermediate and high energies is tricky, demanding negotiation of many depolarizing resonances. Alan Krisch indicated a new solution, describing the success of recent preliminary tests of 'Siberian Snakes' at the Indiana Cyclotron (June, page 23),

and highlighted the continuing interest of spin-dependent measurements, where in some cases the relevant production rates are extremely small. Andy Miller described an internal target facility for KAON that could achieve luminosities of 10^{33} , stressing that such a feature should be supported now if it is not to be 'designed out'.

KAON's intense antiproton beams could be used to create high energy densities inside nuclei, as explained by Bill Gibbs. Exotic atoms and exotic hadron states produced by antiprotons were discussed by Leo Simons and Eberhard Klempt respectively.

Our present understanding of the non-strangeness-changing weak interactions of hadrons is based on high precision experiments which isolate the weak interaction via its characteristic left/right asymmetry

signature. Shelley Page described the need for measurements at energies above 5 GeV, concluding that such experiments could be performed with KAON polarized beams.

Definitive detection of any forbidden decays, in particular of kaons, would challenge the Standard Model and indicate new directions. Extensive work on rare kaon decays is underway at several major Laboratories. Doug Bryman showed how higher intensity beams will allow for much greater precision and sensitivity in such experiments.

The proposed KAON Driver ring (October, page 10) could be a very good source of neutrinos, and the physics potential was outlined by Florian Scheck.

In summarizing the meeting, TRIUMF Director Erich Vogt also

described how the Canadian Laboratory is pursuing its KAON goal, encouraging international partners to contribute to the construction. The strong interest in KAON within the German community was very apparent at Bad Honnef.

Other meetings in the KAON series have been held at TRIUMF itself and at Montreal in Canada, at the Japanese KEK Laboratory, at Coimbra in Portugal, and most recently in Turin, where a special topic was the possibilities for antiproton facilities. A further meeting planned for Vancouver next summer will aim to catalyse the formation of collaborations to develop experimental proposals and to canvass the requirements for beamline and detector design. Further information from Pat Stewart at TRIUMF (STEWART at TRIUMFCL).

Around the Laboratories

CERN First physics from LEP

On 13 October, four days after the end of the first physics run of CERN's new LEP electron-positron collider, all auditorium space and every closed-circuit TV vantage point was taken for presentations by the four experiments – Aleph, Delphi, L3 and Opal.

With good performance from the machine, the experiments had amassed between them over ten thousand Z particles – the electrically neutral carriers of the weak

nuclear force – and physicists were eager to learn the first fruits of the world's largest catch of Zs.

Discovered in the 1983 tour de force at CERN's proton-antiproton collider which resulted in the Nobel prize for Carlo Rubbia and Simon van der Meer, the Z had, until earlier this year, been reserved for the big experiments at the proton-antiproton colliders, first at CERN and then at Fermilab.

With the advent of physics this year at Stanford's SLC linear electron-positron collider, the Mark II detector also joined the action, supplying the first few hundred examples of Zs produced in electron-

positron annihilations. After a sweep across the Z region, Mark II's physicists improved on previous measurements of the mass of the particle. From the Z production rate around the peak, they also got an improved limit on the different number of lightweight neutrino types allowed in Nature (November, page 1). These results showed that there was very little room left for a fourth neutrino type to complement the three (electron-, muon- and tau-types) known so far.

With the deluge of statistics from LEP, the four experiments could significantly refine the accuracy of the Z mass measurement.