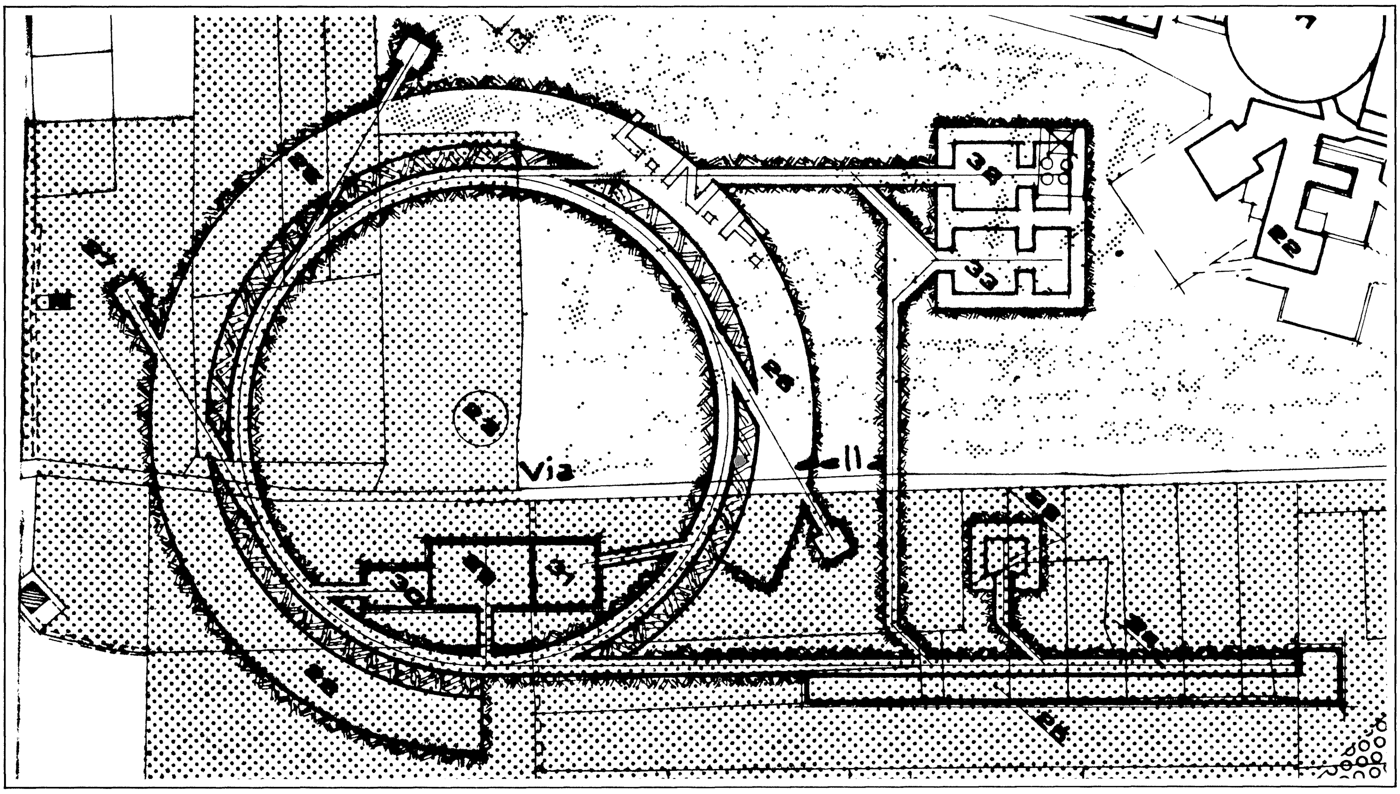
Sketch of the proposed ALFA 3 project at Frascati, which foresees a 1100 MeV electron linear accelerator feeding a 460 m circumference stretcher/storage ring. As well as acting as injector for the ring, the linac could also be used as a neutron source and for nuclear physics experiments.



optimize both physics (in particular as far as energy was concerned) and machine requirements, a completely new electron machine was proposed, with a 1.1 GeV electron linac and a long (460 m circumference) stretcher ring. (The suffix 3 after ALFA indicates the three scientific fields covered by the new facility, rather than the number of revisions of the proposal.)

The dimensions of the ring and a linac energy spectrum compression system mean that r.f. cavities are not required. However by inserting an r.f. system and by using a suitable number of magnetic elements of the lattice, the stretcher can be utilized as an ordinary storage ring providing an energy of 3.5 GeV, and able to create synchrotron radiation, and monochromatic and polarized gamma rays by backward Compton scattering of laser light, while also carrying out internal target experiments. In particular, the synchrotron radiation facility has the so-called All Wiggler Machine (AWM) configuration, with up to 40 light ports from normal and superconducting wigglers installed in the straight sections of the machine.

A neutron source, obtained by the high power electron beam from a low energy (100 MeV) linac output is also planned. A second neutron source, at the high energy end of the linac, enriched in fast neutrons for studies of radiation damage, could also be envisaged.

Finally, it is always possible to use the pulsed beam of the linac — which has an optimum energy spread after the compression system — for conventional single arm experiments in future nuclear physics experiments.

These various advantages and the flexibility to handle different areas of research are seen as the main benefits of using the linac stretcher method to obtain a continuous electron beam.

TRIUMF Kaon factory physics

The second TRIUMF Kaon Factory Physics Workshop was held on 10–14 August, 1981. About a hundred physicists participated in the meeting, which consisted of fifteen invited talks and four afternoon workshop sessions, and proved to be a stimulating and productive event.

The discussions centred on identifying the most important physics that could be studied with a machine providing an increase in intensity of two orders of magnitude in primary proton beam over present accelerators in the energy range 8 to 20 GeV, and on establishing some preliminary guidelines on the desirable properties of secondary beams at such a machine.

Overall it appeared that a very good case could be made for building at least one kaon/neutrino factory somewhere in the world. About ten experimental set-ups could be identified, each of which would make possible several years of important experiments needing the extra beam intensity or purity which such a machine could provide. The main research topics would be charge-parity violation, rare kaon and hyperon decays, baryon spectroscopy, kaon-nucleus interactions and hypernuclei.

The most obvious area of study is CP violation. The kaon system is still the only one in which this phenomenon is observed and, in spite of recent progress in constructing gauge theories of fundamental interactions, it has not yet been satisfactorily explained. More precise measurements of CP violating parameters could help clarify the origin of CP violation, test ideas of grand unification, compare alternative extended electroweak models and study gluon corrections in QCD.

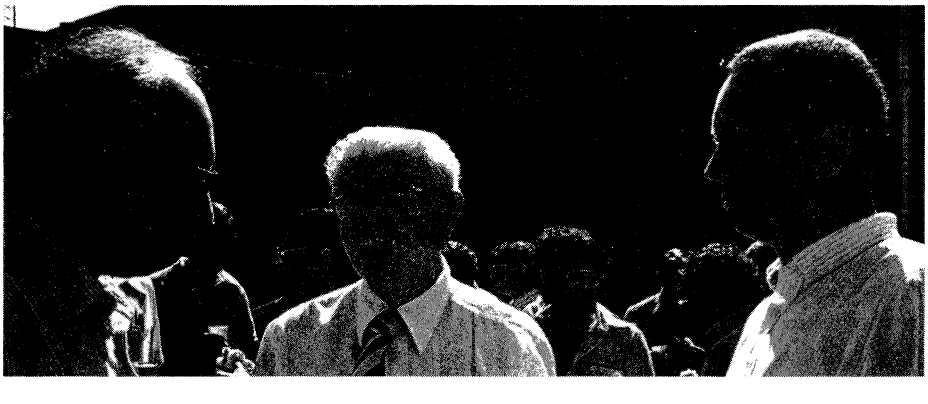
The study of rare kaon decays would also be greatly aided by higher intensity beams. Rare decays can be divided into two categories. First those which involve transition between particle families and thus probe physics at mass scales not directly accessible with accelerators. An example is the decay of the long-lived kaon into a muon and an electron which provides a crucial test of technicolour schemes. Second are those which are allowed as higher order electroweak interactions, such as kaon decays into a pion, electron and positron. Improved measurement of these processes would help reinforce the standard model or discover deviations from it.

Neutrino physics was also discussed. For experimental reasons, a useful neutrino beam would require the addition of a proton storage ring. With a primary beam in the 10 GeV range, a useful neutrino beam of a few hundred MeV, not available at present, could be obtained. Important experiments with such a facility include a precise determination of the Weinberg angle through neutrino scattering and measurements on neutrino oscillations and masses.

The baryon spectrum up to 2 GeV is not that well known. Better measurements of both masses and branching ratios would enable a more stringent comparison to be made with promising new predictions. Polarization measurements in kaon scattering are particularly important.

Because of the weak positive kaon-nucleon interaction, scattering on nuclei should be free of the distorting effects that confuse nucleon and most pion scattering experiments. Positive kaons may therefore prove to be as useful a nuclear probe as very low energy pions but over a broader energy range and with shorter wavelengths.

Improvements in negative kaon beam intensity and purity will make possible systematic measurements on hypernuclei and their excited states — perhaps allowing the study of gamma rays in coincidence — in the same way that is taken for granted for ordinary nuclei. A systematic study of different types of hypernuclei — from the deuteron up – will provide crucial information on both the hypernuclear interaction and on many-body effects.



Left to right, Bob Adair, Reg Richardson and Eugene Pauli consider the possibilities for kaon factories.

(Photo TRIUMF)