

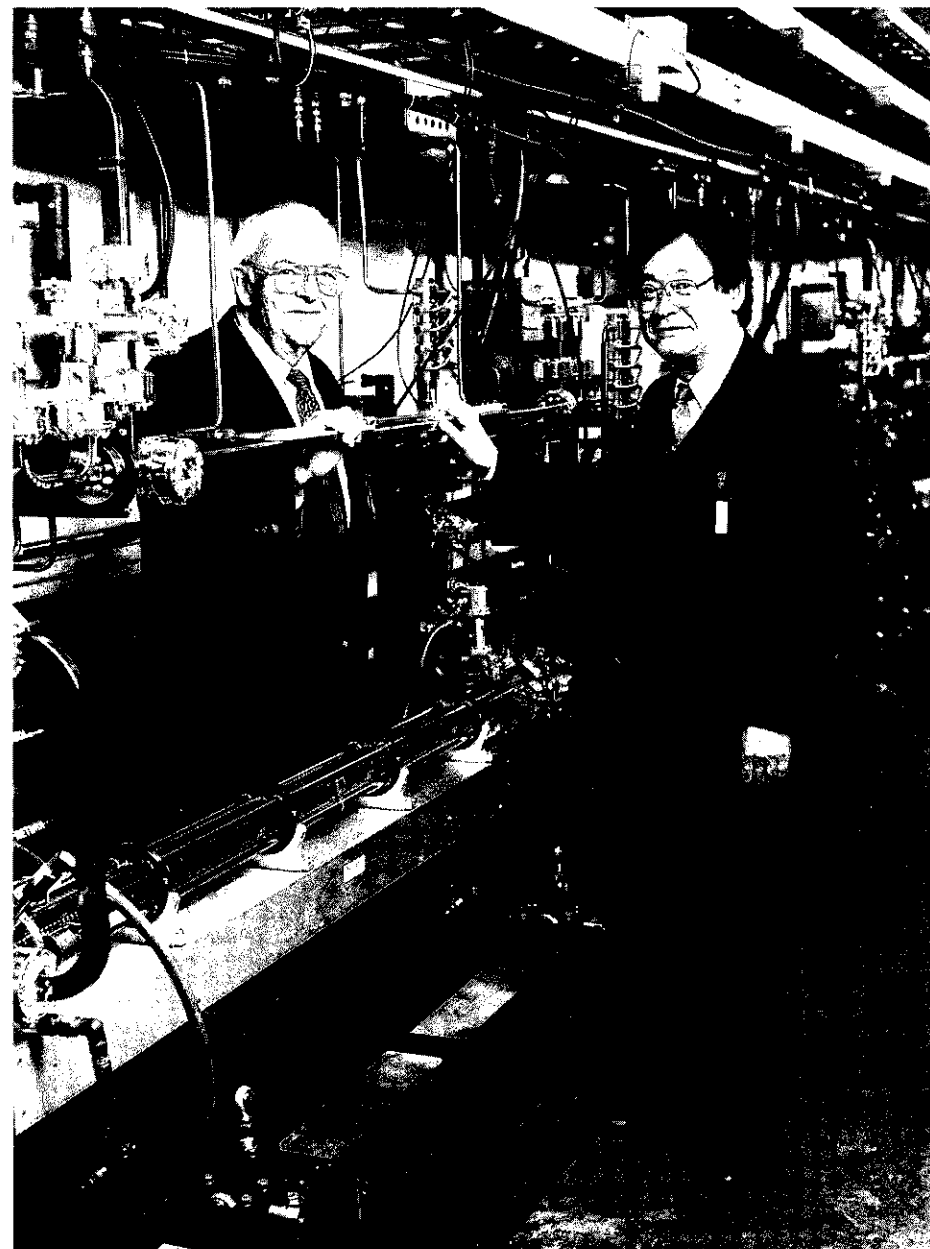
SLAC Director Burton Richter (left) and Japanese KEK Laboratory Director General Hirotaka Sugawara at the Next Linear Collider Test Accelerator at SLAC, built cooperatively by the two laboratories.

ous best measurements were done in Canada by the Canadian National Research Council, CNRC, whose interest in current metrology was motivated by applications in the aluminium industry.

The CERN standards laboratory was assisted by a broad international collaboration including the CNRC and Canadian industry (April, page 5). One of the main problems to overcome was reducing the stray electromagnetic fields generated by bus-bars carrying 20 000 Amps. In order to keep these to a minimum, the bus bars, along with the cage housing the transducer under test, have an innovative and pioneering design. The bus bars are configured very tightly in a positive-negative-positive voltage configuration which reduces the external field by a factor of 25 compared to a conventional bipolar configuration. The cages themselves closely simulate a true coaxial configuration whilst still being compatible with connections to a linear bus bar arrangement. The coaxial set-up minimizes the external magnetic field variations caused by the circulating current and felt by the transducer.

KEK/SLAC Pursuing joint linear collider R & D

Three recent events have substantially quickened the pace toward eventual construction of a next-generation linear electron-positron collider. Both the US Department of Energy's influential High Energy Physics Advisory Panel (April, page 4) and a select review panel of the National Research



Council recommended in February that US physicists should play a major role in an international effort to develop a complete conceptual design for a TeV-scale linear collider.

At about the same time, Japanese KEK Laboratory Director General Hirotaka Sugawara and Stanford Linear Accelerator Center (SLAC) Director Burton Richter signed a memorandum of understanding to do cooperative research and development on linear colliders.

For nearly a decade both KEK and SLAC have been pursuing linear collider research along parallel paths, emphasizing room-temperature copper accelerating structures powered by X-band klystrons. Differences between the two labs' designs have been relatively minor - for example, trading off the length of the twin electron and positron linacs

versus the accelerating gradient within them. Inked on February 6 at the meeting of the International Committee on Future Accelerators in Paris, the joint R&D agreement is an important step by both labs to work together on pre-design optimization studies.

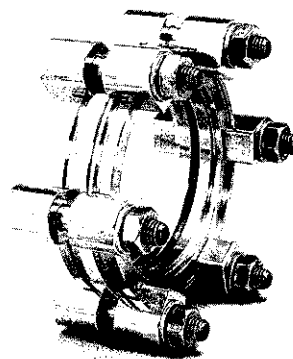
The document makes official what has increasingly been occurring in actual practice. KEK physicists played a huge role in the design and implementation of the Final Focus Test Beam at SLAC. This \$20 million R&D project recently realized its goal of producing beam spots with rms heights of only 70 nanometres - proving that the factor of 350 demagnification needed for a TeV linear electron-positron collider is indeed feasible. And SLAC physicists are making major contributions to KEK's Accelerator Test Facility,

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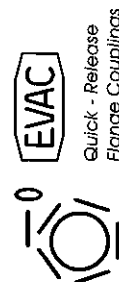
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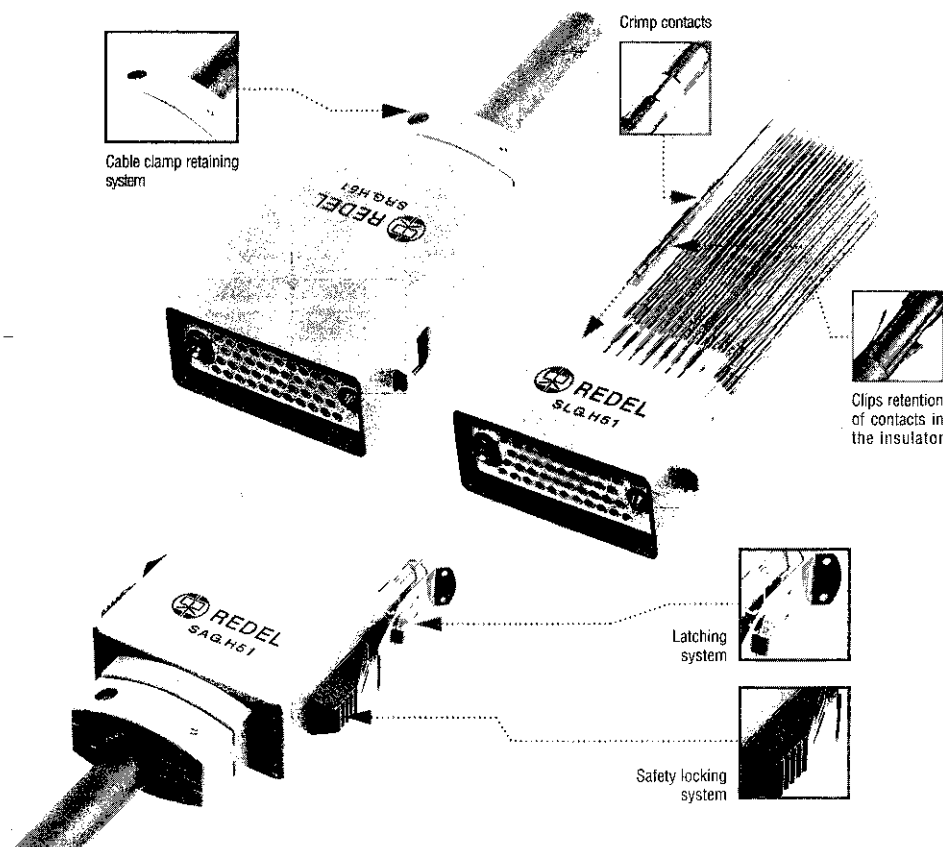
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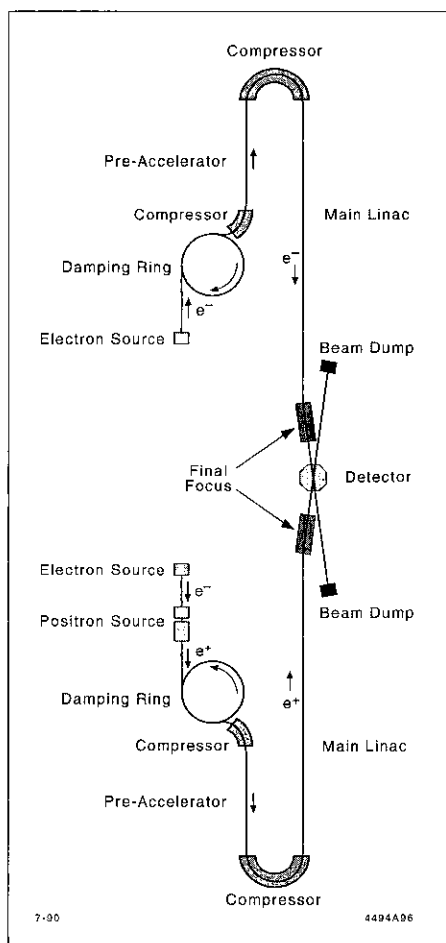
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Possible layout of the Next Linear Collider (not to scale).



which will prototype the injectors and damping rings required for such a machine.

Another important international R&D project now being commissioned at SLAC is the Next Linear Collider Test Accelerator (NLCTA), whose purpose is to construct and reliably operate a fully engineered sector of a TeV machine. This 42 metre prototype now incorporates four 1.8 meter copper accelerating structures of slightly different design, powered by two 50 megawatt, 11.4 GHz klystrons built at SLAC. The microwave power from each klystron is first compressed by a factor of four using a SLED-II pulse compression system developed at

SLAC. The resulting pulse is then split and 100 MW is delivered to each of two accelerator structures.

The fabrication of three of these structures reflects the international character of the project. In each, some 200 copper cavities were machined to micron tolerances by KEK; assembly and bonding of these cavities was done at SLAC. The NLCTA has already achieved accelerating gradients averaging nearly 50 MV/m with acceptable dark currents of a few microamps, and 70 MV/m is expected in individual 1.8 m structures after two more klystrons have been added to allow the instantaneous power level to reach 200 MW. For comparison, the Stanford Linear Collider and the TESLA Test Facility have achieved accelerating gradients of about 17 MV/m (July/August 1997, p. 1).

In actual operation with a multibunched electron beam traversing these structures, the beam loads down the cavities, resulting in a lower gradient for the succeeding bunches in a given train. Physicists working on the NLCTA compensate for this transient beam-loading effect by selectively shaping the RF pulse fed to the structures. With a flat-top pulse, this effect leads to a 17 percent spread in the output electron energies, but this spread can be limited to a mere 0.3 percent by a suitably shaped RF pulse.

The NLCTA provides an ideal test bed to use in refining the design of a next-generation linear collider and addressing remaining unresolved issues. Initial plans call for two 0.9 m and four 1.8 m structures powered by four 50 MW klystrons, together capable of accelerating an electron beam to 450 MeV. A possible upgrade of two additional 1.8 m structures and a total of seven 75 MW klystrons would be able to generate a

1 GeV beam - corresponding to a gradient of 85 MV/m within the structures. This is approximately the accelerating gradient that will be required for a full-scale TeV linear collider.

ITALY

In its continual tour of CERN Member States, the European Committee for Future Accelerators (ECFA) had a major assignment in April when it visited the Frascati and Gran Sasso laboratories to learn about their work and about Italy's continuing impressive commitment to particle physics, at both national and international levels.

The continuing national effort was underlined at Frascati when committee members heard news of the first colliding beams at the new DAFNE electron-positron collider (April, page 24 - an earlier but more comprehensive DAFNE status report appeared in the December 1997 issue, page 12).

Nuclear and sub-nuclear research had a relatively late start in Italy compared to other major European countries. In the mid-1920s, Orso Mario Corbino, influential politician and chairman of Rome physics, pushed for an increased national effort in physics. The figurehead for this effort was Enrico Fermi, recently returned from Göttingen. This science burgeoned, in nuclear physics, in theoretical physics and in cosmic ray research.

After the difficult war years, Italian physics made a new start with the creation of the Centre for the Study of Nuclear Physics and Elementary Particles in 1945, followed by the INFN (National Institute for Nuclear