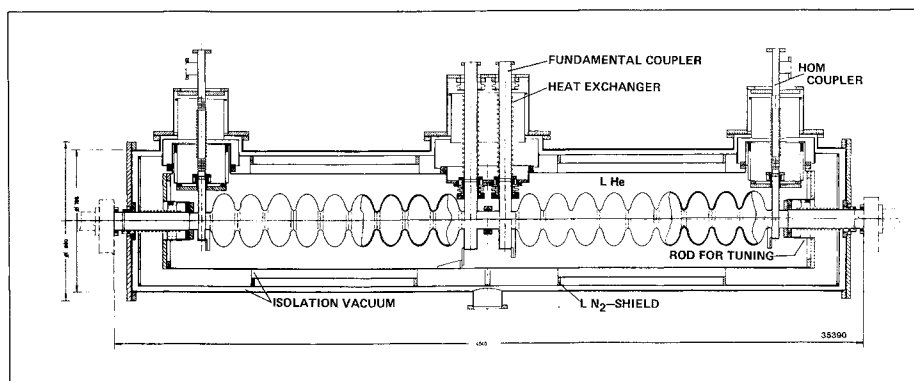


Diagram of the double nine-cell superconducting cavity for PETRA.



PETRA had been built at the Kernforschungszentrum Karlsruhe in a collaboration with CERN and DESY.

On 16 February a superconducting cavity built at CERN was installed in the tunnel of the PETRA storage ring at DESY. At the end of the January/March PETRA shutdown, the cavity was well set up and ready to demonstrate its performance in the presence of stored beams.

The five-cell cavity is designed to run at the PETRA frequency of 500 MHz. It was tested earlier at CERN and provided an accelerating field of 2.8 MV/m. It is made of niobium sheet, electron-beam welded at the CERN workshops. It is equipped with all the facilities needed for operation within a storage ring—a high power coupler, higher order mode couplers and a tuner system.

Beam tests began at PETRA on 25 March. Initially the cavity was excited by the beam without applying r.f. power. A first survey of higher order mode excitations caused by the beam was made. In the evening of 28 March the crew was able to work for the first time with a DESY klystron. Later that night, the superconducting cavity took over the beam and stored it at 7 GeV. For these tests a field gradient of 2.2 MV/m was used and the maximum current stored in two bunches reached 1.7 mA.

The cavity was operated with a

refrigerator from DESY. With its own cryostat and refrigerator control it is hoped to operate it in PETRA for several months and to be integrated as much as possible into the existing PETRA control system.

Meanwhile, possible parameters for a PETRA ring with superconducting cavities replacing the conventional units were presented at the recent Sante Fe Particle Accelerator Conference by a DESY-Wuppertal group. The dissipated beam power (due to synchrotron radiation at 30 GeV) of such a machine would require a new vacuum pipe. To obtain a reasonable luminosity, new quadrupoles, probably of the superconducting microbeta type, would be needed at the interaction points. Upgrading PETRA seems at present very questionable, particularly in view of the recent positive developments of HERA. However superconducting cavities may come in as energy savers and defray their installation costs by reducing the electricity bill, a factor which is also valid for HERA and other accelerators.

As a first step, a prototype superconducting module for PETRA is now being built. The mechanical and cryogenic design of this prototype module fulfils the space requirements of the existing PETRA tunnel. It was chosen to work at 1 GHz for several practical reasons. The 4.2 m space between quadrupoles at PE-

TRA led to a double nine cell structure.

A single cell and a five-cell unit corresponding to the same frequency and dimensions had already been tested. While the single cell provided a relatively high accelerating field of 5.3 MV/m, the five-cell cavity gave an excellent value of 3.2 MV/m.

The first nine-cell unit was completed in the second half of March. These cavities are electron-welded by a German industrial firm and chemically polished at the Physics Institute of the University of Wuppertal. Cryogenics, r.f. components and windows, as well as the cryostat for the test module, are being prepared at DESY to be installed at PETRA in the winter shutdown.

In parallel with these developments, the 1000 inverse nanobarn per day mark was exceeded in March at the DORIS II ring, more than doubling its December performance. The two groups working there, Crystal Ball and ARGUS, are busy keeping up with the increased flow of data. The energy corresponded to the production of upsilon prime, at 5.016 GeV per beam.

Recent measurements at DORIS II demonstrated that the beams there can also be polarized, as was already suspected by the experimentalists. A value of 80 per cent was measured at the upsilon prime energy using the laser light method.

CERN More jets

One of the highlights of last year's physics results was the new evidence for the production of hadron jets in the high transverse energy products emerging from particle collisions, both in the 62 GeV collision energy range at the Intersecting Storage Rings and the much higher

The neutral particle (electromagnetic) energy from a high transverse energy (34 GeV) event as seen by the detector of the CERN/Oxford/Rockefeller team at Intersection 1 of the CERN ISR. Such 'lego plots' are a way of 'unwrapping' the energy deposited over the full solid angle, and are becoming increasingly popular in jet physics.

In the subsequent clustering analysis, signals from neighbouring counters get combined, so that the jets are especially clear (right). But even without subsequent analysis, the pattern of energy as received in the separate counters is jet-like enough (left).

collision energies available in the SPS proton-antiproton collider (see May 1982 issue, page 147, and October 1982 issue, page 327).

New results from the ISR now underline this phenomenon of clustering of the hadronic debris, interpreted as coming from the violent collisions which disturb the quarks (and gluons) sitting inside the target nucleons.

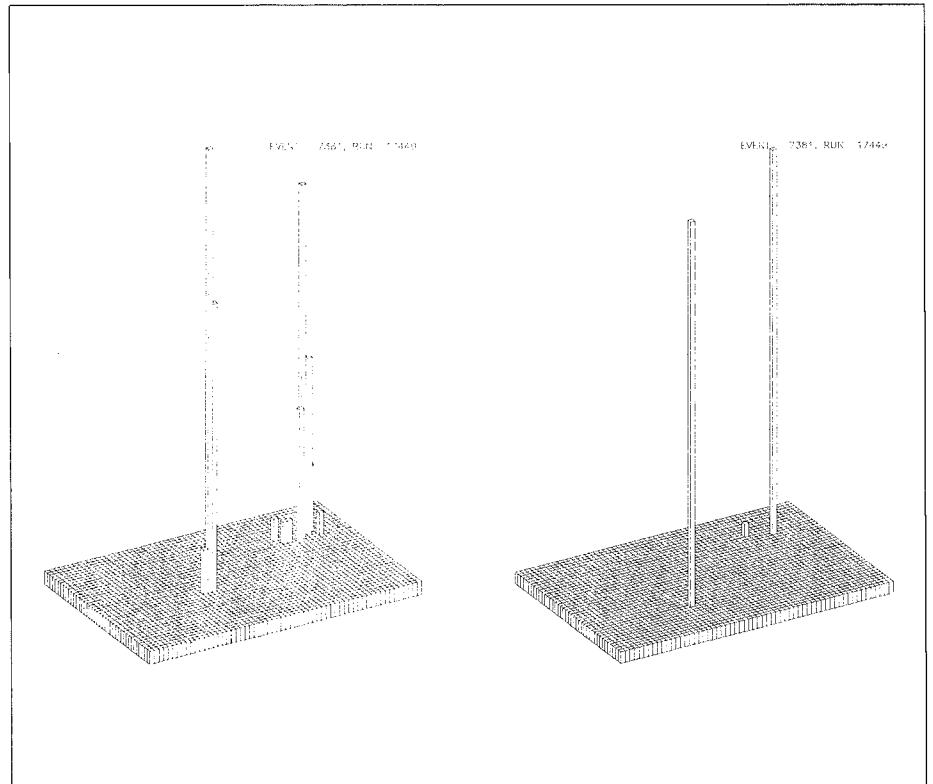
The CERN / Oxford / Rockefeller collaboration at Intersection 1 uses a superconducting magnet around a system of cylindrical drift chambers and lead-scintillator modules. Lead glass modules outside the magnet extend the coverage of electromagnetic showers. It is an improved version of the apparatus previously used by a CERN/Columbia/Oxford/Rockefeller team.

All energies in the interior shower counters and the exterior lead-glass modules were summed, and data taking was triggered if this exceeded a specified level. Multiple events were rejected.

If attention is focused on high transverse energy (up to 30 GeV), there is a marked clustering of the detected neutral particles. This is confirmed by an analysis of each event, which shows clearly how the secondary particles group into two back-to-back sprays as the total transverse energy is increased.

Interesting results are also coming in from the CERN / Dortmund / Heidelberg / Warsaw collaboration working with the Split Field Magnet in Intersection 4 of the ISR. These complement their classic jet studies using single particle triggers (see May 1982 issue, page 147).

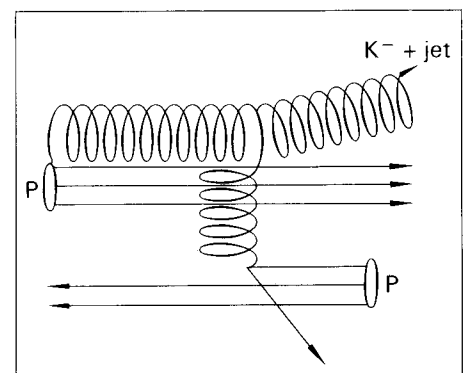
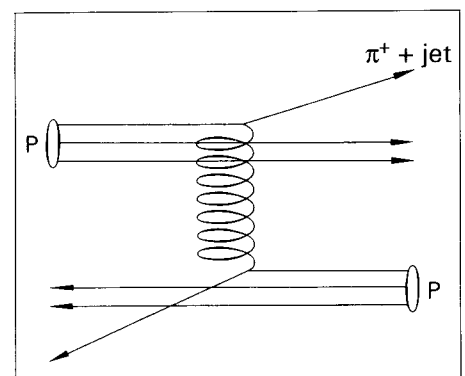
This group has long been among the stalwart supporters of the jet phenomenon. Their triggers select those events which include a single high transverse momentum particle. Although this represents only a small



fraction of jet production, these single particle triggers have a clean signature and provide a convenient way of studying the composition of jet-like events.

The CDHW team now has some further results from a systematic comparison of high transverse momentum positive pion and negative kaon production in proton-proton collisions at ISR energies.

While a positive pion ('up' quark bound with a 'down' antiquark) has quarks in common with the proton (up, up, down quarks), a negative kaon (strange, antiup) does not. However high transverse momen-



Diagrams illustrating the difference between quark-quark (top) and quark-gluon interactions in the production of 'jets' of hadrons. The straight lines indicate quarks and the looped lines gluons. In both cases a gluon is exchanged. The quarks and gluons do not materialize as free particles, producing instead sprays of hadrons.

tum negative kaons are still frequently found in the hadronic debris emerging from these violent collisions in the ISR.

The behaviour of the accompanying particles is found to depend on the type of trigger particle used. In the pion case, two hadron jets are seen to come off predominantly back to back. However the jets in the kaon case are not mutually opposite, indicating that another mechanism might be at work.

As well as quarks, the colliding particles also contain gluons. Different quantum numbers are conserved in gluon and quark interactions (gluons, unlike quarks, carry no explicit 'flavours'). In addition, the quarks and gluons inside hadrons have different characteristics.

The properties of the jets in the two cases are seen to be very different. This systematic difference ties in with the quantum number restrictions and with the observation in neutrino experiments that the gluon component of nucleons is 'softer' than the quark component.

The relative levels of kaon and pion production is also consistent with calculations on the different mechanisms involved. This basic interaction of three gluons (field particles) at one space-time point is something unique to the underlying theory of quark-gluon interactions (quantum chromodynamics). The fact that this interaction can now be measured and successfully compared with predictions greatly extends the confidence in the underlying theory.

Ratio of high transverse momentum events triggered by negative kaons and pions, as seen by a CERN/Dortmund/Heidelberg/Warsaw collaboration at the CERN Intersecting Storage Rings. The observed behaviour ties in with calculations (solid line) which include the effect of three gluons interacting at one space-time point. Leaving out the three-gluon contribution spoils the agreement (dashed line).

STANFORD Preparing for SLC

Preparations for the proposed Stanford Linear Collider (SLC) continue to go well. Two major components, the electron damping ring and the 50 Megawatt klystron performed well in first tests at the end of February. The damping rings are required for improving the beam quality before final acceleration of the bunches and the new klystrons are necessary to increase the final energy of the linac from the present 32 GeV to 50 GeV.

On Sunday morning, 27 February, SLC experimenters watched a beam circulate in the newly completed damping ring. The test followed a series of weekend runs. Although the distributed ion-pumps were not yet on, the beam lifetime was already longer than 3 minutes. In subsequent

tests, this lifetime increased to nearly one hour.

In normal operation the electron beams will be stored for about 5 milliseconds between SLC pulses. The injected beam consisted of about 4×10^9 electrons from the PEP gun with about half the beam concentrated into one bunch.

A new 50 Megawatt klystron for the SLC was successfully tested on 25 February. The 6-cavity tube, operating at a repetition rate of 60 Hz with a 2 microsecond pulse width, produced 52.8 MW at the expected efficiency of 45 per cent. Meanwhile, a second tube has been completed and a third is in bake-out. The next step is to run these tubes with a 5-microsecond pulse and a repetition rate of 180 Hz. This requires building a pulsed high-voltage power supply (modulator) big enough to challenge the new klystrons. Tests are imminent.

