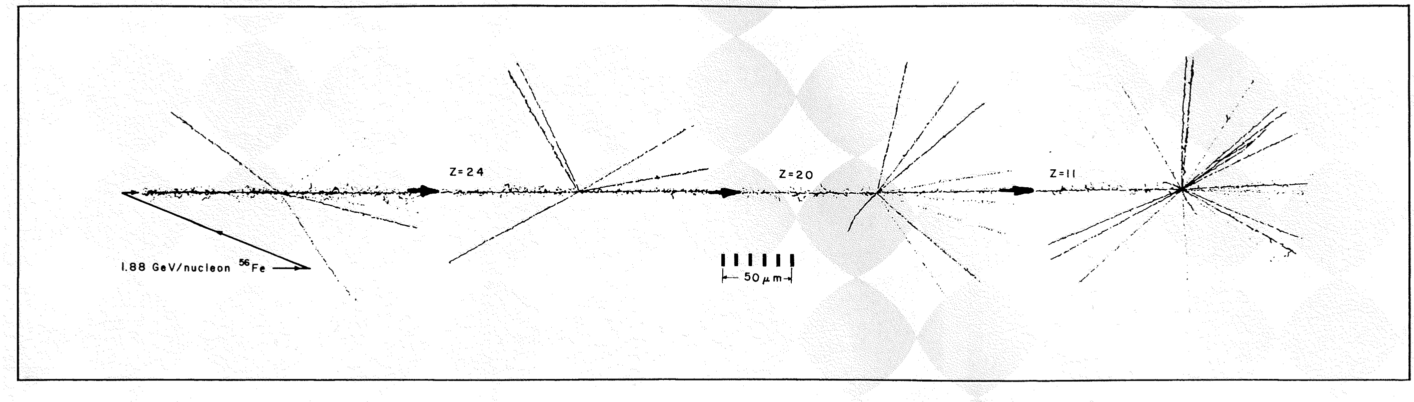
Physics monitor



Although not evidence for quarks, heavy ion experiments at the Berkeley Bevalac have revealed signs of unusually short-lived states in nuclear emulsion. Here is an example of an incoming iron nucleus producing a chain of four successive interactions.

Quark search conference

In spite of (or perhaps because of) the present doctrine of total quark confinement held by the majority of particle theorists, experimental searches for free fractional charge and other anomalous stable particles in ordinary matter have been increasing in number during recent years, using a range of techniques of increasing sophistication and sensitivity.

As a result, researchers in this area had a conference to themselves in June. About 40 participants and 150 observers gathered at San Francisco State University to report progress and discuss future plans, with representatives present from almost every group involved in quark searches.

Direct accelerator searches have seen no fractionally-charged particles of mass below about 13 GeV. However possible candidates for new particles in this mass range have been reported from the Auckland cosmic ray experiment and some anomalous nuclear fragments appear to be present in emulsion experiments with heavy ions at Berkeley.

The majority of the current and planned searches in matter are based on one of three basic techniques — magnetic levitation, time-of-flight spectrometry and electrostatic droplet deflection. Other ideas under development include semiconductor and tunable laser techniques for the excitation and detection of anomalous atoms.

Inevitably, interest at the conference focused on the latest results from the Stanford group which has been reporting apparent fractional charges in over a third of their levitated 0.25 mm niobium spheres. In the opening talk of the conference, W. Fairbank claimed the continued observation of this effect in a further fifteen charge measurements on five spheres. One sphere gave zero residual charge, two gave measurements of $+^1/_3$ and two $-^1/_3$ of the electronic charge (in the experiment, $-^1/_3$ is indistinguishable from $+^2/_3$ or two $+^1/_3$ charges, and vice versa). One of the $+^1/_3$ values remained unchanged for eight levitations, while another sphere changed from $-^1/_3$ to 0 in successive levitations. Fairbank showed measurements of background, which remained constant during successive levitations, and concluded that the measured fractional charges represent a real effect. Nevertheless he has agreed to a 'blind' analysis of future data, incorporating in the computer program a random charge value which will not be known to the Stanford group until afterwards.

In contrast to the Stanford results, G. Morpurgo reported no fractional charges with his levitated iron spheres, obtaining a residual charge consistent with zero in a total of seventy spheres. Since the spheres are of different material and are prepared in different ways, the two results are not necessarily in direct contradiction, but Morpurgo feels that, since the Stanford fractional charges occur so frequently, and are apparently rather easily removed from the niobium spheres, we should expect a significant proportion in other materials also. He is now planning to test niobium-coated iron spheres, and spheres made from a niobium-iron alloy. It is not clear whether it will ever be possible to levitate the same spheres in both the Morpurgo and Fairbank systems.

A direct test of the Stanford claim may now be possible as a result of a new experimental strategy initiated by P. Smith and R. Bennett from the Rutherford Laboratory. The plan is to obtain a large number (ten thousand or more) of new niobium spheres, using the original Stanford material and the same manufacturer. Random samples will be tested by Stanford to confirm that fractional charges are still observed in the new batch, and the remainder will be tested in a series of experiments by a Rutherford / Imperial College / Queen Elizabeth College collabora-

People and things

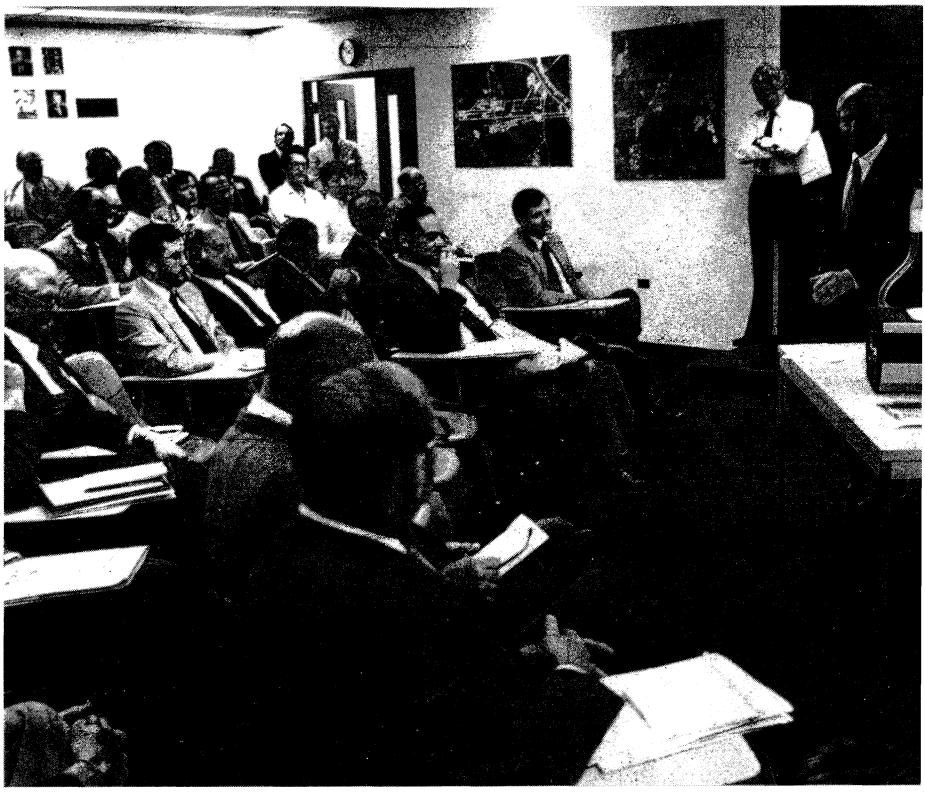
tion which will attempt to confirm and identify the source of the fractional charge. The experimental programme includes evaporation of the material into a time-of-flight spectrometer (see January issue, page 18) and a new electrostatic deflection experiment. The Stanford group is also attempting to develop an independent test in which the spheres are suspended in an air stream and induce a small alternating current in a rotating array of capacitor plates. The hope is that sufficient sensitivity will be achieved to measure the charge on each sphere to better than 1/3.

Other workers favour a more general approach and plan to examine a wide variety of materials at sensitivity levels better than the Stanford result (10^{-17} per atom). This has been made possible in particular by the development of an electrostatic droplet deflection technique by R. Hagstrom (Argonne), G. Hirsch (Berkeley) and C. Hendricks (Livermore) using a stream of uniform size liquid drops (typically two thousand per second, 20 microns diameter) passing through an electric field. The drops separate into discrete integer charge clusters between which any fractionally-charged drops would be clearly detectable. Hirsch and Hendricks are constructing apparatus with a 10 foot vertical flight path, while Hagstrom plans to use a 70 foot tower and 50 micron drop size in order to increase the processing rate.

The remarkable features of the technique are its universality (since almost all materials can be put into liquid solution or suspension) and the quantity of material which can be examined (as much as 10^{-4} g per second or 10^{23} atoms per day, which makes new levels of sensitivity possible for the direct detection of fractional charge in all types of matter). With suitable enrichment procedures, concentration levels down to 10^{-30} or less may be attainable.

Professor Fairbank's son, W. M. Fairbank Jnr., presented a paper on the use of tunable dye lasers to excite and identify specific atoms at the 1 in 10^{19} concentration level. This technique could prove of importance in a variety of experiments requiring extreme chemical sensitivity (one example in particle physics being solar neutrino detection by chemical techniques).

The conference, conceived and organized by G. Fisher of San Francisco State University, was judged to be a success by both participants and observers and attracted considerable media coverage because of the novelty (and unusual simplicity) of the scientific objectives. The conference also produced the first-ever quark t-shirts!



Charles Percy, U.S. Senator from Illinois, addresses the Fermilab Industrial Affiliates first annual meeting and symposium on technology transfer. He stressed the importance of continued emphasis on research and development. More than seventy representatives attended the meeting on 27, 28 May at Fermilab. Participants included John Hulm of Westinghouse, who helped to pioneer the application of superconductivity to bubble chambers, and particle physicist Mel Schwartz who also has his company (Digital Pathways).

(Photo Fermilab)

At its June session the CERN Council appointed René Turlay from Saclay for a three year period of office as a member of the Scientific Policy Committee. It also extended the mandate of F. Herz as Head of the Health and Safety Division until the end of 1981. The Council also expressed its appreciation of the work of Italo Mannelli who is leaving the CERN Directorate, being succeeded by Robert Klapisch. Gregers Hanser