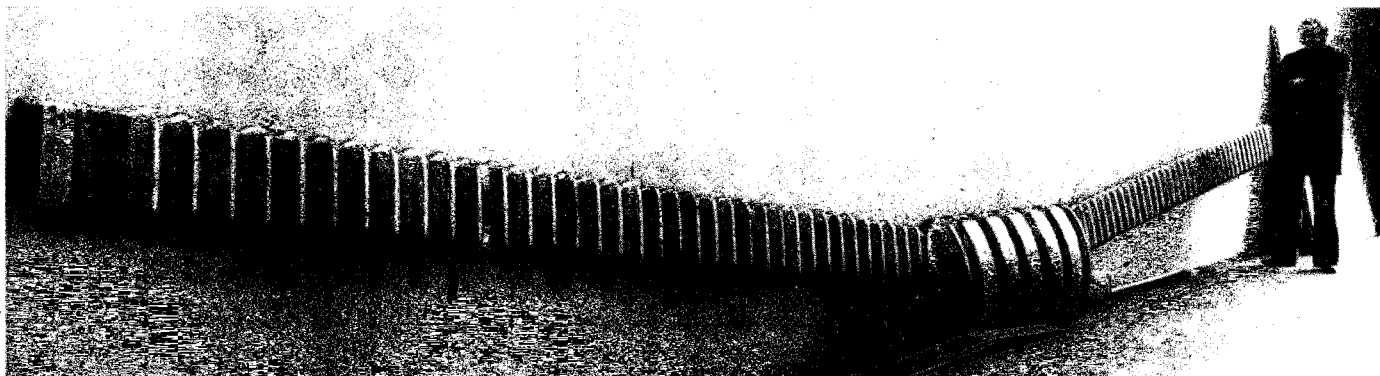


Taken out of position, the vacuum chamber from the Split Field Magnet at the CERN ISR still provokes contemplation.

(Photo CERN 169.2.79)



and it is conceivable that a similar significant K^* contribution is present in the hadronic decay of the D into a kaon and two pions.

The $K\pi$ mass spectrum was then re-examined under the condition that the mass of at least one of the two possible $K\pi$ pairs falls inside the K^* region. After this selection is made, a definite enhancement is seen in the D region. The peak becomes even more pronounced when additional kinematic cuts are imposed.

The enhancement only appears in the $K^-\pi^+\pi^+$ mass combination. Such a positively-charged, negative strangeness state cannot be explained by the old three quark model, and is said to be 'exotic', while other $K^-\pi\pi$ combinations correspond to more conventional quantum number assignments.

The fact that the peak is only seen in the exotic channel indicates that the signal is genuine. The observed width of the peak is compatible with the mass resolution of the experiment.

Subtraction of background shows that a total of about ninety D production events are seen. However an absolute measurement of the cross-section for D production is difficult because it requires model-dependent assumptions for the production process.

Still there

According to the standard quark model, hadrons are built up from small numbers of fractionally charged constituents — the quarks. This model has been highly successful in explaining the observed proliferation of hadrons, and evidence for small constituents deep inside nucleons has now been seen in a whole range of experiments (see January/February 1978 issue, page 7).

However no convincing signs of free quarks liberated from nucleons have been seen, though several experiments have held up tantalizing results. For example, two years ago a Stanford University group reported fractional charges in niobium (see May 1977 issue, page 154).

These experiments used an updated version of the technique originally developed by R.A. Millikan to measure the charge on the electron. While Millikan used d.c. fields and oil droplets from an atomizer, the Stanford experiments use a.c. fields and superconducting techniques. Now after further painstaking work at Stanford, these fractional electric charges — in exactly the one-third units of electronic charge predicted by the standard quark model — are reported to be still there.

In the experiment, tiny superconducting spheres, about 0.01 cm diameter, are made to oscillate by an alternating electric field. These oscillations depend on the charges on the spheres, which are some multiple of the electronic charge, possibly with an additional 'residual' value.

These residual charges could be simulated by small dipole forces and the experimental technique has been improved to allow for such dipole effects. This increases the probability that the vestigial charges of one-third are genuine.

Such quark-type charges were detected on several of the tiny spheres. Also it was found that these charges were affected by electrical discharges in the apparatus, and could be removed by subsequently scrubbing the spheres with acetone. The physicists assert that this is a result of the fractional charges being near the surface of the spheres.

Current theoretical dogma says that quarks are perpetually confined inside hadrons, but this has yet to be proved. Some attempts have been made to construct approximate confinement schemes and, depending on the quark mechanics of these models, it is possible that matter containing free quarks might tend to have a definite chemical behaviour. This could be an explanation of an observation of fractional charges in niobium, but nowhere else.