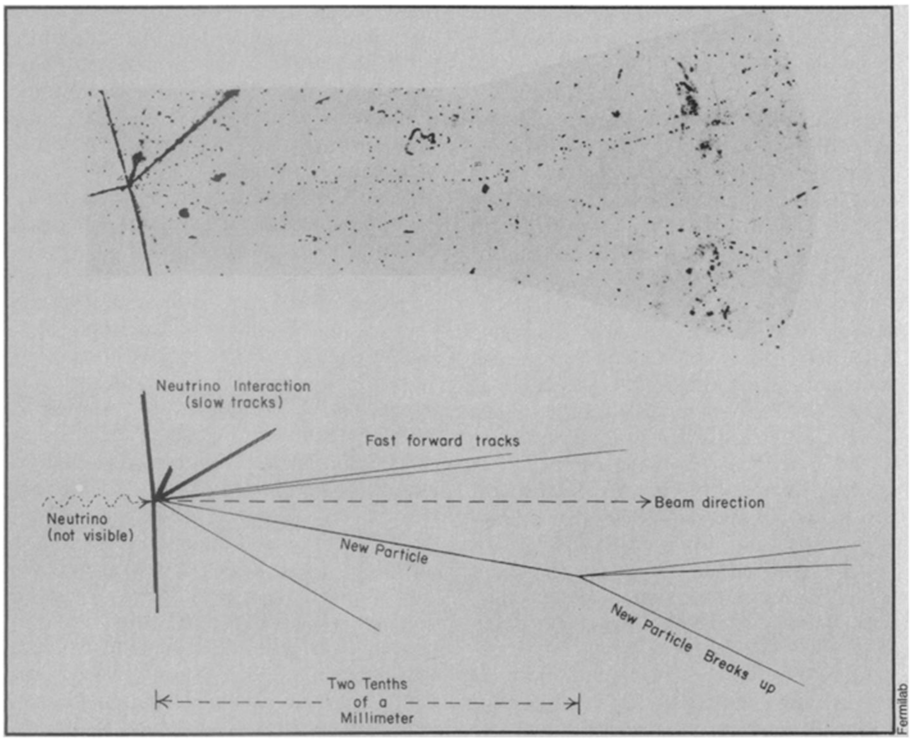
Catching a psi particle in its tracks



Fermilab

First recorded track of a charmed particle follows neutrino interaction in emulsion.

The second anniversary of the discovery of the first of the psi particles, the family of ultraheavy particles possessing the new characteristic that physicists have called charm, has recently passed. In those two years enough evidence has piled up for the existence of this new group of particles to convince the Nobel Prize committee to award the 1976 physics prize to two of the discoverers of the first one.

But up to now, all that evidence, however convincing, has been rather indirect. Belief in the existence of the psi particles has been based on the testimony of their decay products. The psi's, which are produced nowadays in a multitude of different ways, exist for an extremely short time before decaying into other particles. The properties of the psi's have been deduced from the nature and behavior of these decay products.

What had been lacking was a direct picture, so to speak, the actual track of a psi particle. Now that is supplied.

The track was obtained by a collaboration of physicists from seven countries led by E. H. S. Burhop of University College, London, one of the world's most renowned particle physicists. The instrument used was the world's most powerful particle accelerator located at the Fermi National Accelerator Laboratory near Batavia, Ill. Participants came from Fermilab; the Inter-University Institute for High Energies at Brussels; University College, Dublin; the CERN Laboratory at Geneva; Imperial College, London; the Institut des Sciences Exactes et Appliquées in Mulhouse, France, the University of Rome and the Université Louis Pasteur at Strasbourg.

The reason the actual track of a psi particle escaped detection for so long has to do with the shortness of their lifetimes (on the order of a few times 10^{-13} seconds) and the nature of the detectors used in previous experiments. Either the charmed particle did not live long enough to enter the detectors, or, if it was created within them, it did not last long enough to make an impression. The detectors in question do not record the track of a particle as a continuous line, but as a series of dots (usually made by spark flashes) through which a line can be drawn. The lifetimes of the psi particles are so short that they tend to fall between the dots.

To detect a psi track Burhop and his collaborators used a block of nuclear emulsion. This is a more sensitive (and three-dimensional) version of the coating familiar on photographic film. Many particles besides light will make the same sort of dark impression in the emulsion. Tracking in an emulsion is a follow-the-dots procedure too (it depends on the particle's impressions on individual atoms), but the dots are much closer together.

Still, the lifetime of a psi particle is so short that even if one could be created in the emulsion, finding its track among the myriads of other tracks in the emulsion (from other particles in the same experiment, background radiation, cosmic rays, etc.) was a formidable task. The emulsion was surrounded by an array of other detectors to record the decay products of a possible charmed particle and give the scanners a direction fix on the part of the emulsion to examine. In the end, a track 0.2 millimeters in length was found, which, from the surrounding circumstances, the physicists believe is that of a charmed particle. Which particular one it is has not been determined. The formal report will appear in a forthcoming issue of PHYSICS LETTERS. ☐

Doubt over discovery of element 126

Great excitement was caused in the worlds of physics and chemistry last summer by the announcement that evidence for the existence of element 126 had been found in certain inclusions in samples of the mineral monazite that came from ancient deposits in Africa (SN: 6/26/76, p. 404). The splash sent ripples through nuclear physics, chemistry and even weapons technology. The existence of element 126 in such old minerals (as well as other superheavy elements for which evidence was alleged) would mean that these nuclei were much stabler than physical theory had suggested. Answering the question whether such nuclei are fissionable under the impact of thermal neutrons could tell whether it might someday be possible to make bombs with far less fuel than current nuclear bombs require.

Since the original report, by Robert V. Gentry of Oak Ridge National Laboratory and six others, scientists in various countries have been examining monazite samples looking for evidence of element 126 to confirm or refute the finding. According to Albert Ghiorso of the Lawrence Berkeley Laboratory, who recently gave a talk that included a summary of the current state of the affair 126, conclusions of other parties are increasingly negative, and there is a growing skepticism that element 126 does, in fact, exist in these ancient monazite samples. "It would be very startling if the discovery was confirmed," Ghiorso told SCIENCE NEWS.

Ghiorso did not do any of the element-126 experiments himself, but he has been involved in the discovery of numerous other transuranic elements and is regarded as a foremost expert on superheavy nuclei. He says he was skeptical of the element 126 claim from the beginning and he was not surprised when a meeting of interested scientists held at Caen, France, during the past summer came to a generally negative conclusion.

The claim is based on an examination of what are called giant haloes in the monazite samples. These haloes are apparently due to radiation damage, and the giant ones seemed likely to be due to damage by very heavy radioactive nuclei. The experiment Gentry and his collabo-