The Village Crier

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MAJOR DISCOVERY ANNOUNCED BY EXPERIMENTERS AT FERMILAB

An experimental group working at Fermilab has announced that their experimental results produce evidence of the existence of a new particle with an entirely new physical property. This new property may correspond to one that was predicted by theoretical physicists several years ago.

The experimenters -- representing the University of Wisconsin, the CERN Laboratory at Geneva, Switzerland, the University of California Lawrence Berkeley Laboratory, and the University of Hawaii collaborating as Experiment #28A, a study of neutrino interactions -- made their observations in pictures taken by the 15-ft. Bubble Chamber filled with a mixture of liquid hydrogen and neon. The 97,000 pictures taken for Experiment #28A were taken between April and June, 1975.

...15 ft. Bubble Chamber yields new experimental results...

Neutrinos are elusive, massless, chargeless particles first discovered through the study of radioactivity. They are used at Fermilab as powerful probes of the structure of matter. In the usual interactions of neutrinos with protons or neutrons the neutrino is transmuted into a negatively charged muon, a particle belonging to the "lepton" family, a family which also includes electrons and neutrinos. In such an interaction the proton or neutron, both members of another family of particles called hadrons, is fragmented into other particles which are also members of the hadron family.

The experiment performed at Fermilab has so far revealed four events of special interest among about 1,000 neutrino interactions. These results were reported at a conference held in Irvine, California on December 5, 1975. Since then, additional work has been done to confirm the analysis.

...New data verified by External Muon Identifier...

All four events exhibit a negatively-charged muon, a positively charged electron (called a positron), and a neutral K meson. In two of the four events, the muon hit a special detector designed to differentiate muons from pi mesons, the most common subatomic particles observed in the fragments of protons and neutrons.

This is the first time that two leptons, (a positron and a firmly identified negative muon) have been observed together with a neutral K meson, a particle that carried a property known as "strangeness."

The mass of the new particle seems to be about twice the mass of a proton. Since

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the positron and the K meson appear to come directly from the point of neutrino interaction, the lifetime of the new particle is estimated to be shorter than 10^{-13} seconds.

These events are interpreted by the experimenters as involving the production of a new particle in the neutrino interaction, a particle which then decays into a neutral K meson, a positron and an invisible neutrino. The original neutrino turns into a muon.

The characteristics of the new particle fit predictions made by one theory of fundamental particles. This theory predicts the existence of a family of new particles which could decay for example, into a strange particle, such as the K meson, and a pair of leptons, such as the positron and neutrino, as in the four events that have now been observed.

For a number of years, theorists have been remarkably successful in interpreting the behavior of subatomic particles by considering them to be composed of various combinations of three fundamental building blocks called "quarks." In attempts to reach a unified understanding of all forces acting among subatomic particles, theorists have found a need for a fourth kind of quark they whimsically christened the "charmed" quark. They have argued that there must exist a family of new particles which contain these charmed quarks. Such particles should exhibit a new physical characteristic, called "charm." An intensive search for particles exhibiting the property, "charm," has been under way for some time. Verification of their existence would constitute an important breakthrough in our struggle to understand the structure of matter.

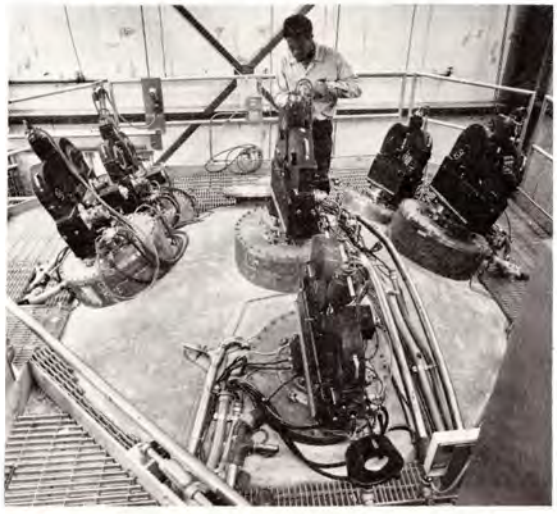
The events observed by the team working at Fermilab seem to fit into the predicted behavior of "charmed" particles. Three other apparently similar events have recently been reported to have been found at CERN. After many years of searching, the observations of these experiments constitute the strongest evidence for the validity of the charm theory. An earlier observation at the Brookhaven National Laboratory has also been interpreted as possible evidence for charm, and another new particle discovered a year ago at Brookhaven and Stanford, may also be a manifestation of the existence of "charm."

Up to the early 1950's, physicists dealt with fundamental particles such as neutrons, protons, and electrons which are familiar constituents of the atom. Then a new family of particles was discovered involving a new characteristic called "strangeness." This discovery of "strangeness" opened up a new field of fundamental particle research. The recent, unusual observations parallel in many ways the discovery of "strangeness" of the early 1950's and presumably will stimulate new experimental and

Continued...

...EMI collaborators (L-R) L. Stevenson, V. Peterson, F. Harris...

...Jack Fry in violin workshop at the University of Wisconsin...



...Ron Davis checks one of six cameras on the 15-ft. Bubble Chamber...

theoretical investigations.

Spokesman for the experimenters is Jack Fry, professor of physics at the University of Wisconsin. The Wisconsin group has worked for many years with so-called "heavy liquid" bubble chambers. The run with the neon-laced Fermilab chamber caps a series of experiments that began in the early '60s at the Bevatron and moved on to the ZGS at Argonne and to CERN. A technical staff at Wisconsin, honed with years of experience, helped the experimenters to move quickly through the film.

Fry is also an authority on the construction of violins. About a year ago Fry gave an interesting talk at Fermilab on this subject including demonstrations of many test violins. With more than 70 violins in his workshop at the University of Wisconsin, he is looking for the secrets of the famous Stradivarius violins. Using scientific techniques, he has made contour maps of the thickness of the backs of a dozen borrowed Stradivaris, trying to unlock the subtle relationship between stiffness, weight and shape of the parts and the characteristics of the wood used. This analysis has led him to design a new instrument which adds a third mode to the two of the traditional violin and which he hopes will sound quite different from the violin and will have more even voicing over a wider range of notes.

Jack Fry has led the study of a large portion of E28's 97,000 pictures in the scanning facility at the University of Wisconsin. Of the neutrino interactions visible in their pictures, they have so far found four interactions that display the unique signature. (One of these interactions is reproduced in this issue of the Village Crier.)

For many years the Berkeley and Hawaii members of the team have worked at Fermilab, designing and building the External Muon Identifier (the so-called EMI) that is now a permanent part of the 15-ft. Bubble Chamber. The EMI is attached to the outer shell of the vacuum tank of the 15-ft. Chamber. It operates simultaneously with the chamber and is an important aid in the interpretation and confirmation of both neutrino and anti-neutrino interactions in the Chamber. To analyze some events of this type and to compare with physical models, the outgoing muon in the events must be distinguished from other tracks in the Chamber. Only muons can make it through to the EMI so that the EMI provides a definite label. This type of label is only available here at Fermilab.

The EMI "fathers" commute regularly to and from Fermilab to California and Hawaii. They were at Fermilab last week at the time of the announcement of the discovery.

The new finding is another triumph for the Fermilab Neutrino Area. Although it has always been ex-

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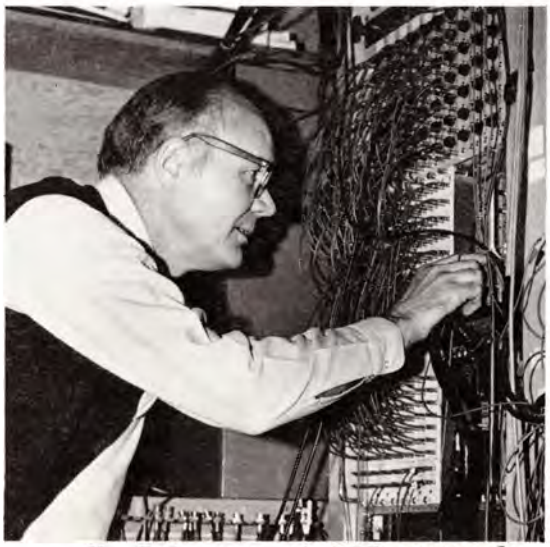
...Neutrino Area, July 1975...

...Beam Window, 15-ft. Chamber...



...V. Peterson at EMI controls...

pected that "neutrino physics" would be among the most important studies at Fermilab, neutrino experimenters have been able to announce two important research results in one year. Experiment #1A (now Experiment #321) with equipment located in Lab C of the Neutrino Area, produced evidence of the neutral current and recently announced the finding of another unusual particle, which they refer to as the "Y" particle in an article they published in the January Scientific American. The University of Wisconsin is participating in this experiment also, together with the University of Pennsylvania, Harvard University, and Fermilab.

The large useful volume of the Fermilab 15-ft. Bubble Chamber, combined with its versatility in its use of liquid hydrogen, deuterium, neon, or neon-hydrogen while exposing it to beams of neutrinos, anti-neutrinos and hadrons, makes it one of the most powerful tools in high energy physics in the world. The beam from the Fermilab accelerator produces a record number of neutrinos, filtered through carefully-structured equipment which is part of the 1-1/2 mile Neutrino Line. Billions of neutrinos are produced with each pulse of the accelerator, but only one particle interacts each minute, to be captured by experimenters' detection devices. The skilled, knowledgeable crew keeps the Chamber operating continuously when experimenters are trying to record these interactions.

Collaborators on Experiment #28A are:

CERN - D. Haidt
G. Harigel
H. Wachsmuth

University of California
Lawrence Berkeley Laboratory - A. Barbaro-Galtieri
P. Bosetti
G. Lynch
J. Marriner
F. Solmitz
M. L. Stevenson

University of Hawaii - R. Cence
F. Harris
S. Parker
M. Peters
V. Peterson
V. Stenger

University of Wisconsin - J. Von Krogh
W. Fry
U. Camerini
D. Cline
R. Loveless
J. Mapp
D. D. Reeder

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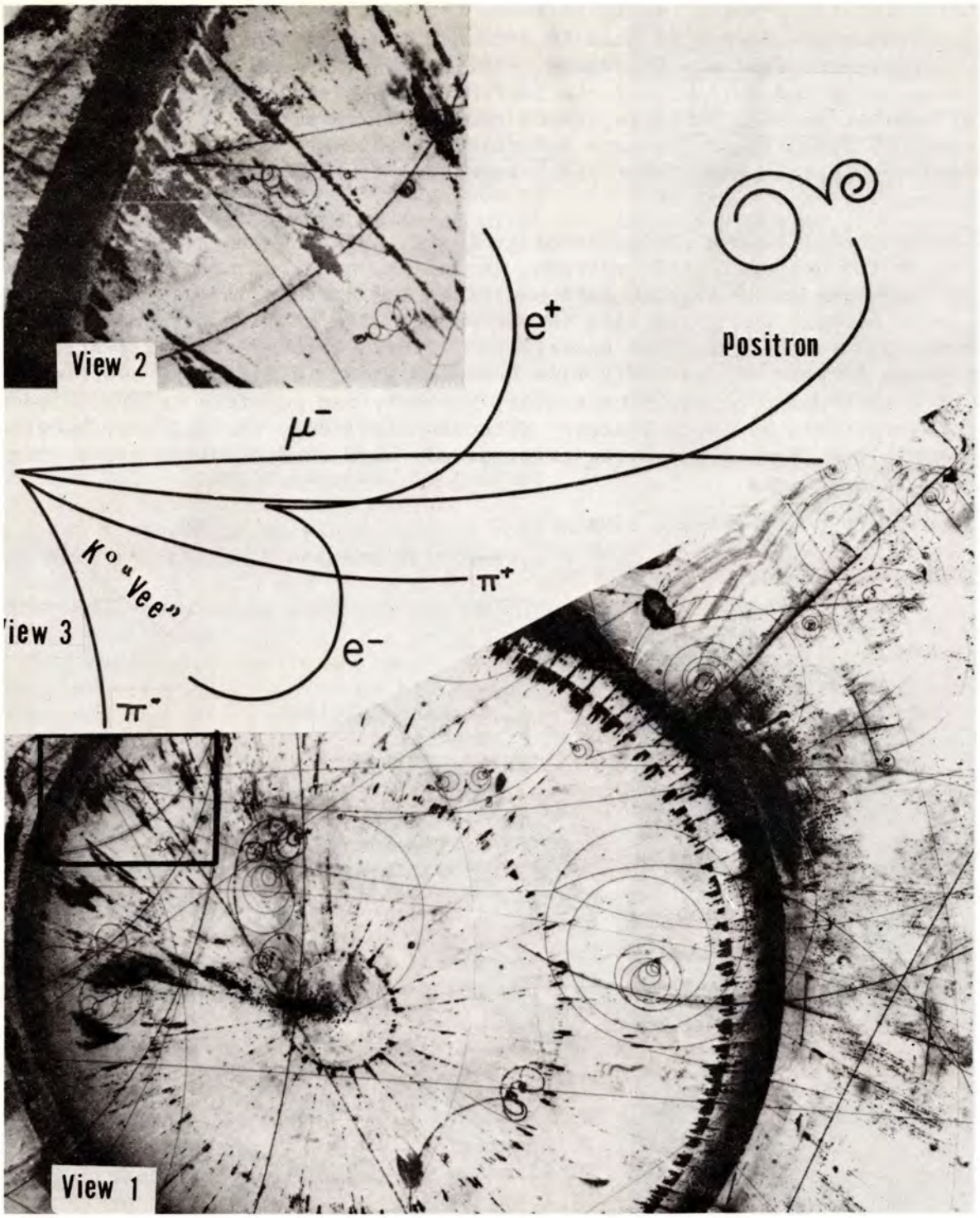

...This is a composite photograph showing one of the four unusual events found in the Fermilab 15-ft. Bubble Chamber during a run filled with neon and hydrogen, exposed to the neutrino beam, as recorded by Experiment #28A.

The event consists of two charged tracks and a "vee." One charged track is definitely identified as a positron by annihilation at the end of its path. The other track, labeled μ is identified by the EMI outside the chamber as a muon. The first vee is a K^{o} that breaks apart into two charged pions. The second vee (labeled e+ e-) helps to identify the positron.

View 1 above is the entire photograph of "Event 3" of E-28A. View 2 is a close-up of view of the rectangle outlined in View 1. View 3 is a schematic explanation of Event 3.

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IN MEMORIAM

William S. Landreth, 59, an employee of RRS, Inc., assigned to security duty at Fermilab, died Wednesday, December 24, at Central DuPage Hospital. He was taken to the hospital by the Fermilab ambulance after he was found unconscious at his post in Lab A of the Neutrino Area by Neutrino Area personnel.

Mr. Landreth had worked at Fermilab since September, 1974. He lived at 1923 Kevin Drive, Aurora. Funeral services were held at the Dieterle Memorial Home in Aurora on December 29, with burial in Lincoln Memorial Park.

Mr. Landreth is survived by his widow, Virginia, and four daughters.

Memorials may be sent to the attention of Capt. Hendrickson, RRS, Inc., Site 55, Fermilab.

William S. Landreth

STOP SMOKING CLINICS IN AREA

Dr. Charles Lang, Fermilab Medical Officer, announces that in observation of National Education Week on Smoking, January 11-17, county-wide "Stop Smoking" clinics are being held to help people quit smoking cigarettes. The times and places of these clinics are posted on the bulletin board in the Atrium. More details available by calling 887-2424.

THIS MONTH AT FERMILAB

Friday, January 9	-	International Film Society presents "The Pawnbroker." Auditorium - 8 p.m.
Thursday, January 15	-	Happy Hour 5-7 p.m. - Village Barn.
Sunday, January 18	-	Hockey Trip - Hawks vs. Phillies, $7.00 ticket includes bus fare, beer, food. Tickets from Ellery Cook, Ext. 3734.
Thursday, January 22	-	West End Jazz Band at the Users Center, 6:30 p.m.
Friday, January 23	-	NALREC Sock Hop, 8-12 p.m. - Village Barn.
Saturday, January 31	-	Choreographers Showcase - 8:30 p.m. Tickets on sale at Guest Office, CL 1W.

CLASSIFIED ADS

FOR SALE - AKC Reg. Great Dane Puppies, born 12/7/75. R. Kerber, 851-0866, or E. Moore, 851-0134.

SUBLEASE/LEASE - 2 bdrm, 2 bth, apt, free htg, no dep., 5 mi. from Fermilab. $255/mo. Sparrow Point in Naperville. 420-7604 evenings.

FOR SALE - 20 gal. Aquarium,std,pump, filter,plants,$25. Cheryl X3351;Chris,896-9895.

WANTED: - Deer rifle in good condition. George Villa, X4161.

FOR SALE - 1968 Chrysler, w/radio, air, power windows, seat, 2 new snow tires. Call Bale, X3719.

FOR SALE - Lemon gr. fully lined fiberglass draperies, 82" lg, 280" w. Xlg, HD Tra.rod with hardware, $50, also forest gr. vinyl rec. chair, 3-position,$50. C. Plezbert, X3205 or evenings 469-0959.

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