

# The Village Crier



fermi national accelerator laboratory

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## SEARCH FOR NEW PARTICLES AT FERMILAB

The announcement by SLAC and Brookhaven in November of the discovery of the Psi (or J) particles ushered in an exciting new era in high energy physics. A special workshop was held at Fermilab on December 8 and 9 to hear proposals by experimenters for experiments to be carried out at Fermilab that could enlarge the vistas opened by the new discoveries. The experiments are aimed not only at understanding the properties of the new particles but also looking for possible other members of the family, and seeing how they might all interact.

More than twenty new proposals were submitted to the Laboratory in the weeks following the initial discovery. The search had already started by Experiment #87 in the Proton Area.

For help in understanding the discovery, many people have turned to Dr. Ben Lee, head of the Fermilab Theoretical Physics Department. With Mary K. Gaillard -- then on the staff at Fermilab -- and Jonathan Rosner of the University of Minnesota, Lee wrote in August a paper, "Search for Charm." One feature of the article, in addition to its profound scientific impact, is its dialogue style, a conversation between an enthusiastic supporter of the hypothetical property, "charm," and a devil's advocate.

Many of the properties of the psi (J) found in the SLAC and BNL experiments parallel the properties of a particle dubbed  $\phi_c$  by Gaillard, Lee and Rosner. Dr. Lee has prepared the following summary of the charm hypothesis, one of the most promising explanations for the new effects.

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Particle physicists all over the world have been buzzing with excitement at the discoveries of new particles made at SLAC, Brookhaven and Frascati in Italy about a month ago. The first of the new particles has a mass of 3.1 GeV and a lifetime of  $10^{-20}$  seconds. It is heavy and relatively long-lived in the scale of subatomic particles. The discovery of this particle, called "psi" or "J," was followed by the discovery of another one of mass 3.7 GeV at SLAC.

These discoveries have prompted many theoretical speculations. One is that these objects are made up of a new kind of fundamental building blocks of matter -- whimsically christened as the "charmed" quark.

The addition of the charmed member in the quark family -- in the normal quark picture there are three "ordinary" quarks already--leads physicists to expect that there



...J. Rosner (L), B. Lee, authors of "Search for Charm," with M. Gaillard...



...M. Paul, Director's Office, reviews stack of proposals received for Psi-J experiments...

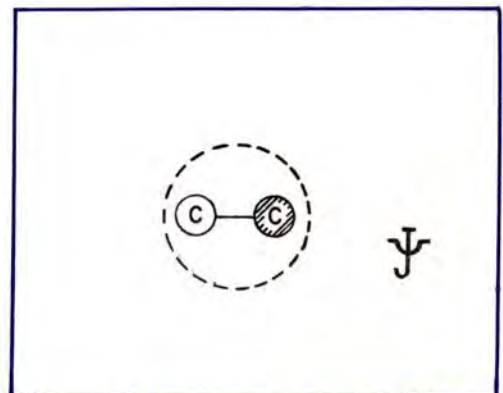


Fig. 1 - New particle is assumed to be made up of a charmed quark and a charmed antiquark (antiquarks are hatch-marked spheres). Symbol a compromise of Psi ( $\psi$ ) and J...

NEW PARTICLES (Continued)

are many more particles still to be discovered. Ordinary particles -- those that we work with at Fermilab -- are made up of two or three quarks. For example, the proton is made up of three ordinary quarks. The pi meson is made up of an ordinary quark and an ordinary antiquark. The K meson is made up of a strange quark and an ordinary antiquark (the strange quark is one of the "ordinary" quarks; it is a building block of strange particles). If there is a fourth quark, it stands to reason there must be particles which are made up of ordinary and charmed quarks. Such particles are called "charmed" particles.

Some theorists have wanted this fourth quark in order to fortify a theory which will unify two of the fundamental forces among particles -- the electromagnetic and weak forces. A prediction of this theory is the neutral current effect, observed at Fermilab and elsewhere early this year. These theorists reason that the newly-discovered particles are made up of a charmed quark and its antiquark, with a strong bond between them as shown in Fig. 1. The large mass of the new particle is due to the mass of the hypothetical charmed quark. These theorists suggest that its mass is several times bigger than those of ordinary quarks. Its relatively long lifetime is explained in terms of the difficulty of the pair of the charmed quark and antiquark to turn into an ordinary quark and antiquark pair. At SLAC and Brookhaven, the pure form of energy created in a violent collision of particles sometimes materializes as the coupled charmed quark-antiquark pairs.

If there are charmed quarks and antiquarks, they may form pairs with ordinary antiquarks and quarks. These are the "charmed mesons" shown in Fig. 2. Theorists predict that the lightest of them would weigh 2.2 GeV. They also believe that charmed particles have to be produced in pairs. That is, in a particle collision, one particle containing a charmed quark and another containing a charmed antiquark have to be produced. The energy produced in the accelerator here at Fermilab is sufficiently high to perform this feat.

There will be at least 35 charmed particles to be discovered: there are six charmed members to be discovered in the pi meson family, and twelve in the proton family, and so on.

The massive charmed quark is expected to decay into three quarks, one of which is a strange quark, as shown in Fig. 3, in about  $10^{-13}$  seconds after it is created. This means that a charmed meson will fission into two or more ordinary mesons, one of which is a K-meson which contains a strange quark in about  $10^{-13}$  seconds as illustrated in Fig. 4. Experimentally, detection of such a decay is one way to verify the existence of a charmed meson. At Fermilab energies, the particle might travel one hundredth of an inch.

If charmed states of matter indeed exist, their creation and observation are well within the capability of the Fermilab facilities. If such particles are discovered, it is a crowning achievement of today's science and technology. Mankind will be a step closer to the truths of Nature, to the pursuit of which this laboratory is dedicated. It will be a vindication of our belief that indomitable human spirit will triumph.

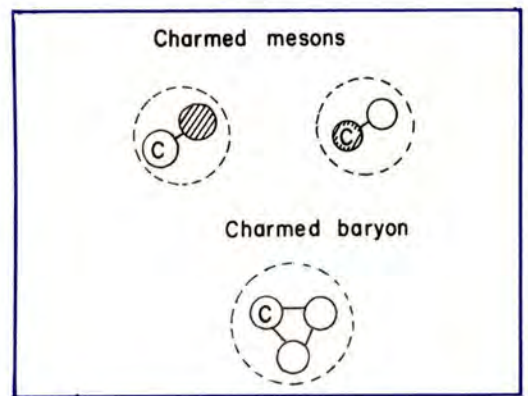


Fig. 2 - Charmed mesons are composed of a charmed quark and an ordinary antiquark, or an ordinary quark and a charmed antiquark...Charmed baryons are made up of 3 quarks, one or more of which are charmed quarks...

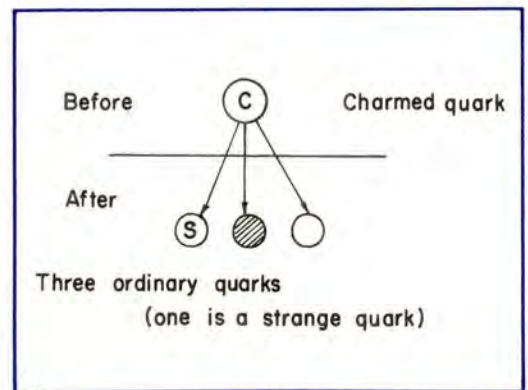


Fig. 3 - Massive charmed quark decays into three ordinary quarks, one of which is a "strange" quark...

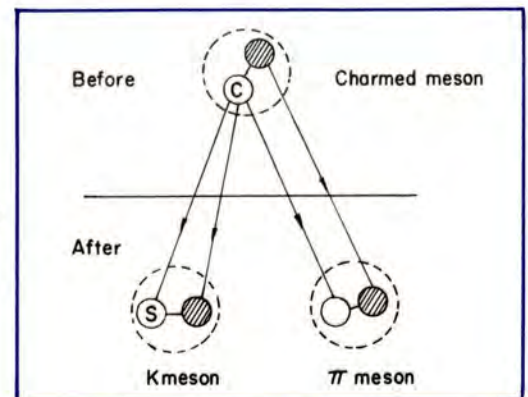


Fig. 4 - Charmed meson fissions into a K meson and a pi meson when the charmed quark decays...

IN MEMORIAM  
DARRELL J. DRICKEY

Darrell J. Drickey, associate leader for the Fermilab Energy Doubler project, passed away Tuesday, December 10, 1974, after a brief illness.

Dr. Drickey joined the Fermilab staff in the summer of 1974, on a year's leave of absence from his position as Associate Professor of Physics at the University of California at Los Angeles. He was also Chairman of the Fermilab Users' Executive Committee and participating in Experiment #216 at the Meson Area.

In 1970, Drickey led the U.S. scientific team carrying out the first Soviet-American scientific exchange, sponsored by the USSR State Committee on Atomic Energy and the U.S. Atomic Energy Commission. This was a pioneering effort in the field of international cooperation, as well as being one of the first successful measurements of the radius of the pi meson. The work was conducted at the accelerator at Serpukhov near Moscow.

Professor Drickey received a B.S. from the South Dakota School of Mines and Technology in 1956 and a Ph.D. in experimental physics from Stanford University in 1963. He spent the year 1963-1964 at the linear accelerator at Orsay, France, and then returned to the Stanford Linear Accelerator Center where he was a staff member until 1968. During this period and subsequent to his appointment to the faculty at UCLA, he played an important role in a number of experiments conducted at these laboratories and also at Brookhaven National Laboratory. He is credited by his colleagues with providing inspiring leadership and significant technical insights, often the crucial difference between success and failure in the field of high energy physics.

In addition to his work on the energy doubler research at Fermilab, Dr. Drickey was continuing his study of the structure of the pion, as spokesman for Experiment #216.

An avid outdoorsman, he enjoyed fishing, hiking and camping with the same enthusiasm which so markedly characterized his scientific work.

Survivors include his widow, Martha, a son Roger and two daughters, Sheryl and Linda.

A memorial service was held at the Congregational Church of St. Charles on Thursday, December 12. A graveside service was also held in Rapid City, South Dakota.



*...Darrell J. Drickey...*



*...D. Drickey (center); Glenn T. Seaborg, (L) former head, U.S. Atomic Energy Commission; A. M. Petrosyants, Chairman Soviet State Committee on Atomic Energy, 1970...*

## FAMILY TOUR DECEMBER 27

Fermilab's Public Information Office will conduct a "Family Day" tour on Friday, December 27. Requests for such a tour have come from students who will be out of school then and who wish to see the Fermilab facility. The group will be limited to 50 people and may be attended by reservation only, first come, first served. Call soon if your family wishes to participate -- Cheryl Stadtfeld, Ext. 3341.

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## SOLAR ENERGY CLUB SEEKS MEMBERS

Fermilab's Solar Energy Club is looking for new members. The club is currently building collectors for an installation in one of the farmhouses in the Fermilab Village. The club meets Tuesdays and Thursdays at 5 p.m. and on Saturday mornings. According to John O'Meara, SEC president, one big advantage of club membership is the opportunity to learn how one could build a do-it-yourself solar energy system. Call him at Ext. 3392 for further description of club activities.

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## BASKETBALL CLASSIC DECEMBER 19

Fermilab's two basketball teams -- the Hustlers and the Protons -- meet head-on tonight, Thursday, December 19, at the Batavia Junior High. Both teams are up for the classic which promises to be a great game to watch. Be there at 8 p.m. Playing for the Hustlers will be Jerry Peterson, Doug Booth, Homer Cunningham, Dave Billingsly, Jeff Ruffin, Nelson Sample, James O'Hara, Issac Sikes, Clarence Rodgers and Joe Davis. On the Protons team are: Gary Smith, James Parker, Clarence Bowling, Tyrone Thomas, Mike Armstrong, Willie Stitts, Wayne Waldon, Bobby McNeal, Mike Wilks and Roy Justice.

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...MONDAY, DECEMBER 23, HOLIDAY LUNCHEON SPECIAL - *Prime Rib, Potato and Vegetable, Roll with butter or Dessert, Choice of Beverage* - \$2.00...

## CLASSIFIED ADS

BORROWED OR LOST? - Please return to E-98 a Wild Optical Level borrowed from us in the past few months. W. A. Loomis, ext. 3613, 3846.

FOR SALE - Brunswick Antique Pool Table, 55 yrs. old. 4½' x 9', completely refinished, new felt and cushions. Leather pockets. Balls & cues included. \$1,000 or offer. D.Smith-3555.

FOR SALE - 7' Starlight stainless steel Christmas tree with mirrored, musical revolving stand. \$60.00 offer. M. W. Morgan, ext. 3088.

FOR SALE - Standard Royal typewriter. Older, heavy model, good cond., \$20. Call Marilyn Griffin at 232-2550 (week days) or 584-2801 (evenings).

FOR SALE - 25" RCA color T.V., table model w/table. T.V. studio monitor, extra powered chassis, super picture. W. Riches, ext. 3779.

FOR SALE - Silver Mellowtone 12-string guitar; new strings, very good cond., \$100 Firm. Call Kathy Hutson, ext. 3638.

FOR SALE - Truck Cap Insulated 8' 24" high w/sliding front window \$195. Camper Furnace, 6500 BTU's \$65. 12 Volt DC Refrig. \$135., Snow Mobile Trailer \$195. D. Tokarz, ext. 3363.

FOR SALE - Gas stove (Zoppas), 4 fires, oven and cabinet \$30. A.Ruggiero, 3802, or 665-7083.

FOR SALE - 2 Goodyear suburban polyglas, w/studs, F78-14, used one winter. \$50. Bob Peters ext. 3724.

FOR SALE - Tri-Star Capacitive Discharge Ignition system, used about 5,000 mi. \$30. Dick Figlik, Ext. 3281.

FOR SALE - 13" original equipment tire for Pinto, spare, never used. \$12. M.W. Morgan, 3088.

FOR SALE - 1974 VW Camper w/Pop Top, Radio, Heater, Stove, Refrig., Sink, Table, 2 dbl. beds, & hammock. 20+mpg. Take over payments w/Credit Union. Elaine ext. 3404 or 851-0134 after 5:30.