FERMINEWS

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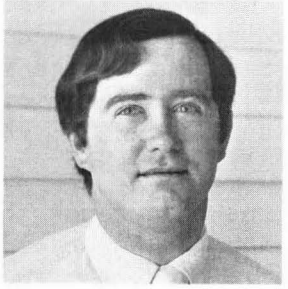
FERMILAB RESEARCH SUMMARY AVAILABLE

...L.Lederman ...



...C. Quigg ...

A layman's guide to the aims and accomplishments of Fermilab's research program during 1978 has been written by Leon Lederman, Director Designate, and Chris Quigg, head of the Fermilab Theory Department. Copies of the publication are available from Technical Information, CL 3E, or from the Public Information Office, CL 1W.

The authors summarize the historical evolution of physics discoveries, particularly in the 20th century. They also point out that the astrophysicists' view of stellar evolution has been greatly altered by recent discoveries in high energy physics, particularly neutral current interactions.

"It is now believed that because of the same neutral current interactions the neutrinos remain imprisoned within the central core of the star during the explosion. Further developments in neutrino astronomy may make it possible to observe the eventual release of these neutrinos, when some reach the earth, to directly test the new ideas of stellar evolution which discoveries in high energy physics have inspired."

The role of quarks as elementary particles making up the strongly-interacting particles is also explained by Lederman and Quigg. They describe the specific contributions made by fourteen Fermilab experiments in 1978 to some of the most basic questions now facing high energy physics: Quarks as Constituents, How Many Quarks? What is the Significance of the Fifth Quark? How Do Quarks Move? The Nature of Neutral Currents.

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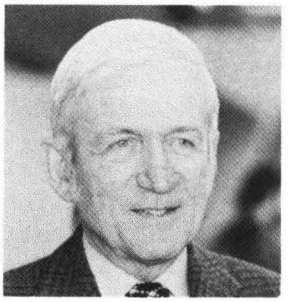
NORMAN RAMSEY HEADS ANNUAL APS MEETING



...N. Ramsey ...

Norman F. Ramsey, president of Fermilab's governing body, Universities Research Association, and outgoing president of the American Physical Society, presided at the annual meeting of the Society held in New York January 29-Feb. 1. Some 1,500 physicists from around the country gathered at the meeting to hear and discuss approximately 450 scientific papers. The 57 sessions of the meeting embraced the gamut of physics research, application and education.

At a ceremonial session on Tuesday, January 31, Dr. Ramsey, who is also Higgins professor of physics at Harvard University, bestowed the 1979 Dannie Heineman Prize for Mathematical Physics on Gerard 't Hooft, professor of theoretical physics at The Netherlands' University of Utrecht. The award included a $5,000 check and a citation to 't Hooft "for his contributions to quantum field theory, in particular for his studies of the renormalization and other features of non-Abelian gauge theories, all represented by outstanding publications in the field of mathematical physics."

A popular version of 't Hooft's remarks at the session, titled "A Labyrinth in Color Space or How Quarks Find Themselves Permanently Trapped," appears on page 2 of this FERMINEWS. He explains his theory of why quarks cannot be seen in experiments performed thus far.

Leon Lederman, Fermilab Director Designate, was guest speaker at the joint American Institute of Physics-National Association of Science Writers luncheon held on Tuesday, January 30, in conjunction with the four-day APS meeting.

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A LABYRINTH IN COLOR SPACE or "HOW QUARKS FIND THEMSELVES PERMANENTLY TRAPPED"

G. 't Hooft, Institute for Theoretical Physics, University of Utrecht
(edited by Chris Quigg, Fermilab)

The nature of the forces that keep quarks permanently together in a hadron can be explained in a theory with "colored" electric and magnetic fields by studying the topological properties of this system.

In 1963 it was realized independently by Gell-Mann and Zwieg for quarks, Ne'eman for SU(3) that all elementary particles of the "hadron" family may have a relatively simple internal structure. Some of them (protons, neutrons) are made of three subunits, now called "quarks". There are a few different types of quarks that may be chosen, and by now most of the possible combinations of three have been observed as a particle. Other hadrons (pion, kaon) are made of one quark and one "antiquark".

This general picture, for which there now exists overwhelming experimental evidence, poses one serious theoretical problem: free quarks have never been seen, despite numerous ingeneous attempts to produce and observe them. Free quarks would have quite striking properties such as fractional electric charge.

Apparently the forces that keep the quarks together are very strong and effective. Most particle theories, however, only work well if the inter-particle forces are sufficiently weak. A new approach is necessary. We divide the problem into two parts. One: derive the masses and other properties of the observed particles in terms of properties of the quarks. Two: explain why the quarks can never separate and be observed singly. Some moderate successes have been booked in answering question one, but it was always necessary to start with a model where some assumption was made concerning question two.

We now have a precise hypothesis to explain why quarks do not come out. Quarks are assumed to have some sort of "charge", a little bit different from ordinary electric charge. Identical charges repel each other, opposite charges attract each other. But, strangely enough, three different charges can also attract each other, so that three-quark bound structures can exist. This charge is called "color", because of an analogy with color vision: the three fundamental colors, red, green and blue can neutralize each other by producing white when they are put together.

Physicists can now qualitatively understand the consequences of these ideas, together with quantum-mechanical effects, for the color forces. For one thing: there are not only color-electric but also color-magnetic forces. It is proposed to apply the mathematics of superconductors and superfluids to these color-magnetic forces.

One then finds that as a consequence of *magnetic* superconductivity, the *electric* force fields tighten up to form narrow, unbreakable bonds connecting the color-charge carriers (quarks). It is as if the quarks are tied together with elastic strings that can switch positions but never break. This is precisely what is indicated by experiments, because some scattering experiments can be interpreted as if these elastic strings are stretched and vibrate, as if someone played a tune on them.

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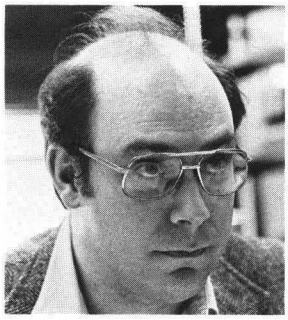

BRUCE CHRISMAN MOVES TO BUSINESS OFFICE

Bruce L. Chrisman has been named Assistant Business Manager of Fermilab, to become Business Manager on July 1, 1979. He replaces Richard Lundy who moves to the Energy Doubler Magnet Division.

Chrisman received his S.B. in physics from the Massachusetts Institute of Technology in 1964. He earned his master's and doctorate in physics at the University of Illinois, then went on to the University of Chicago where he earned an M.B.A. in Finance in 1975. He came to Fermilab in September, 1970 as a programmer in the Computer Group. He became an Executive Assistant in the Accelerator Division in November, 1975.

In addition to his administrative duties, he has been a member of an experiment in the Meson area and another in the Neutrino area.

"The Business Office has a fine group of people who go largely unsung at the Laboratory," Chrisman comments. "I believe that this is because they are doing an excellent job of keeping the business aspects of the Laboratory transparent to the technical activities. I am looking forward to working directly with them."

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INTER/NATIONAL FILM SOCIETY PRESENTS

"DIAL M FOR MURDER"

Saturday, Feb. 10, 1979 8:00 p.m. Fermilab
(Note change of date) Auditorium

Starring three 1950's film favorites - Ray Milland, Grace Kelly, and Robert Cummings - this is an Alfred Hitchcock classic. It is the story of a man dependent on his wealthy wife for support but afraid she will desert him for another man. He plots her murder, and Hitchcock takes care of the rest. It is considered a brilliant combination of Hitchcock and screenplay. Rated PG.

Adults - $1.50 Children - 50¢

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REMINDER: Applications for URA scholarships are due before March 1, 1979 for students entering college in the fall of 1979. See Ruth Christ, Personnel, CL6-E.

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PSYCHOLOGIST TO GIVE SIGMA XI LECTURE

Dr. Elizabeth Loftus, assistant professor of psychology at the University of Washington, Seattle, will discuss "Eyewitness Testimony" at the February 1 meeting of the Amoco Research Center Sigma Xi chapter, at the Amoco Research Center, Naperville. The lecture will be given at 8 p.m.

Dr. Loftus has written five books and over 50 scientific articles on the subject of human perception, memory, thinking, learning and eyewitness testimony. She has consulted in or testified at about 50 criminal trials as an expert on human perception and memory, the most recent case being a court martial in Korea.

Dr. Loftus received her Ph.D. in experimental psychology from Stanford University in 1970.

The Amoco Research Center Sigma Xi Club is sponsored jointly by Fermilab, Wheaton College, and the Amoco Research Center. Sigma Xi is a national organization with local affiliating chapters all across the country. Membership is transferrable from one chapter to another. Marvin Johnson, assistant head of the Fermilab Research Services group, is president of this chapter.

The ARS Sigma Xi will sponsor four more lectures, one each month, in the spring of 1979. The March 8 lecture, "How to Solve Complex Problems Without Being Smart," by Simon Ostrach, will be given at Fermilab. Nobel Laureate Donald Glaser, inventor of the bubble chamber, will appear at another lecture, date to be announced.

The Sigma Xi lectures are open to the public without charge. No tickets are necessary. A Sigma Xi member will be at the Amoco Research Center entrance on the night of February 1 to direct visitors to the auditorium.

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NOTICE:

Neil Harris lecture entitled "From the Emporium to the Shopping Mall" has been rescheduled for Friday, March 16th at 8 p.m. in the Fermilab Auditorium. Tickets already issued will be honored. If not being used, call Ext. 3124.

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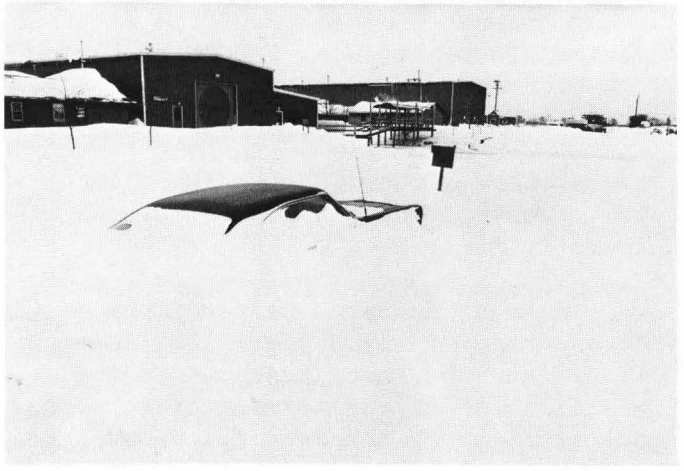
THE BLIZZARD OF '79



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