THE PULSE

For the Personnel of the Laboratory for Nuclear Science

Volume 4 Number 3 ********** July 1996

The Pulse may now be viewed on the World Wide Web at location: http://mitlns.mit.edu/~elsye/pulse.html

Inside

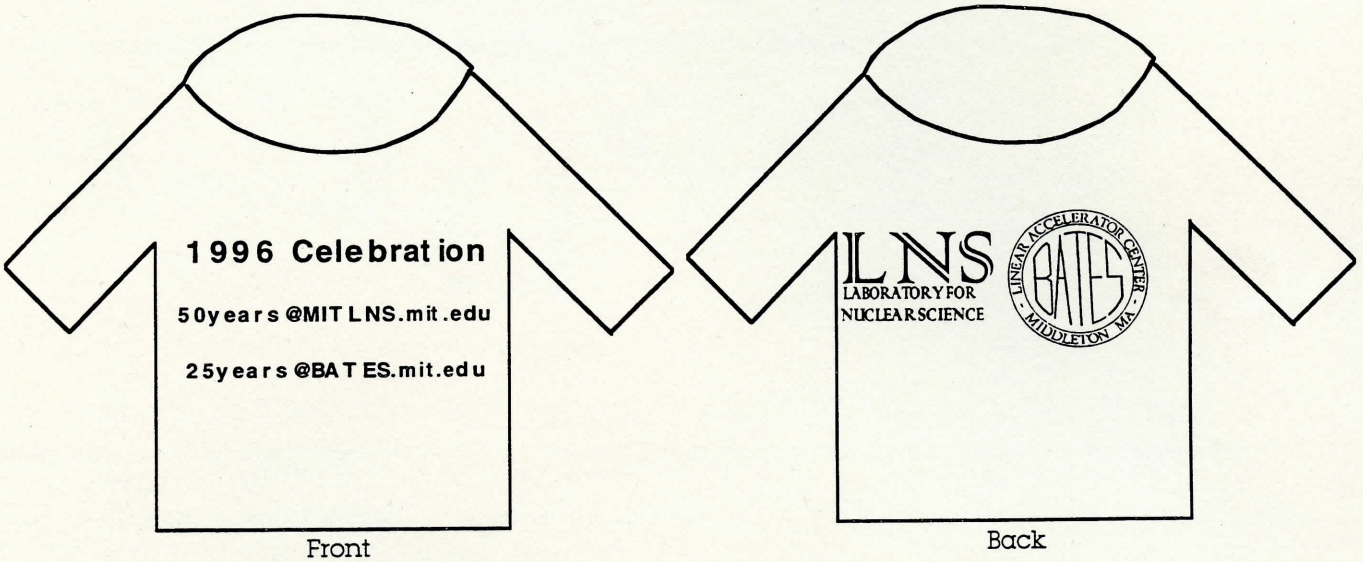
LNS Time Line

1946 Bruno Rossi, Victor Weisskopf, and Jerrold Zacharias join Physics Department from Los Alamos National Laboratory

1946 Zacharias becomes the first director of LNS

1946 Cosmic ray group is started with Herbert Bridge, Robert Hulsizer, Mathew sands, Robert Thompson, John Tinlot and Robert Williams

1946 - 7 Electron scattering by nuclei research by W. Buechner, H. Feshbach & Robert Van de Graaff



Front Back

Celebrate a Milestone T-shirt Sale

Now you can purchase your own commemorative T-shirts and sweatshirts in honor of the 50th Anniversary of LNS and the 25th Anniversary of Bates. These classy items are white with navy print. The T-shirts are made of 100% pre-shrunk cotton, and the sweatshirts are 50% cotton/polyester blend. Both are available in Large and Extra-Large.

To order, send e-mail to flanagan@mitlns.mit.edu, or return the order form below with CASH or CHECKS made payable to MIT-LNS.

Yes! I want a commemorative LNS/Bates shirt!

T-shirts at $10 each: _____ (no.) Large _____ (no.) XL

Sweatshirts at $12 each: _____ (no.) Large _____ (no.) XL

Total amount enclosed: _____

Name:_____

Address:_____

LNS Time Line

1947 First calculation of Lamb shift by French & Weisskopf

1947 First measurement of angular correlation of nuclear gamma rays by Brady and Deutsch

1947 Nuclear Reaction Theory by Feshbach, Peaslee & Weisskopf

1947 Development of triggered multi-plate cloud chambers by Bridge

LNS Update

LABORATORY FOR NUCLEAR SCIENCE

No. 8 July 1996

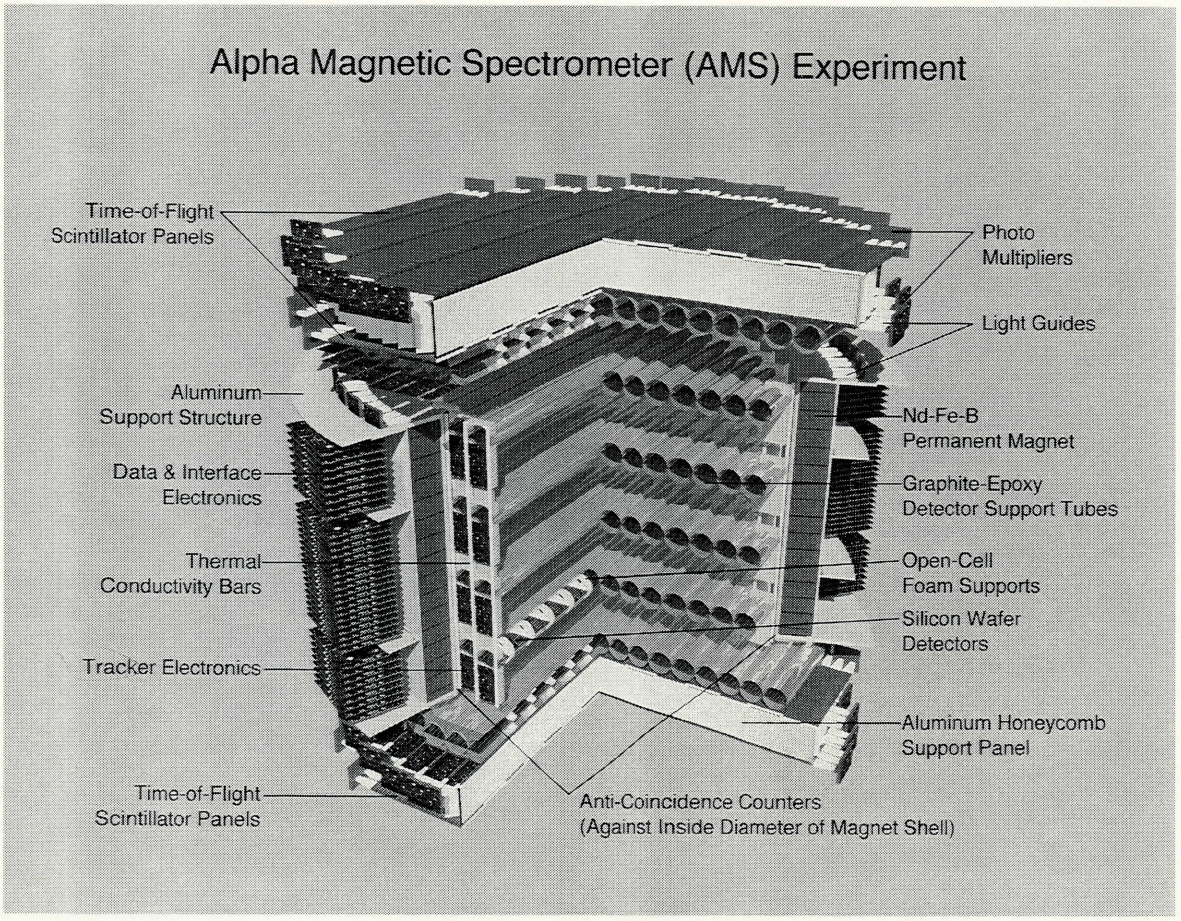


Figure 1

The Alpha Magnetic Spectrometer (AMS) Collaboration and the Search for the Origins of the Universe

Does appreciable antimatter exist in the universe? Does dark matter make up 90% of the universe? These are the pressing questions that face the AMS Collaboration.

The AMS Collaboration will be the first large permanent magnet experiment ever placed in the Earth's orbit to search for the properties and origin of cosmic particles and nuclei. The goal is to increase our knowledge and scientific understanding of the origins of the universe. The experiment may even lead to the discovery of antimatter stars and galaxies. The U.S. part of the project is sponsored by the US Department of Energy and NASA. The prototype will fly aboard the NASA space shuttle in May 1998 and then in 2001 the detector will be a part of the International Space Station Alpha (see Figure 1).

Dirac first proposed symmetry between matter and antimatter in the early 1930s (1). Physicists think that at the time of the Big Bang that there must have been equal amounts of antimatter and matter. Over the last half century it has been shown that all elementary particles (quarks and leptons) have their own antiparticles. Also during this period of time a number of fundamental discoveries have been made in astrophysics using sensitive radio, optical and infra-red telescopes, with satellites measuring UV, X-ray, and gamma-ray photons, with ground based air shower and Cherenkov arrays and with balloon and satellite experiments studying energetic particles. However, because of the high cost and extreme difficulty of putting a superconducting magnet into orbit an experiment such as AMS has not been launched before.

In the early 1960's Bruno Rossi, George Clark, Robert Hulsizer, Herb Bridge and other members of the Laboratory for Nuclear Science were pioneers in the study of cosmic rays and in the development of space science. The Laboratory was responsible for the Gamma-Ray Satellite Experiment, which also was supported by NASA. The prototype was assembled for a balloon flight test and later was part of both Explorer X and Explorer XI.

In the 1970s a group led by Luis Alvarez of Berkeley developed a superconducting magnetic spectrometer which was to be flown on the second High Energy Astronomical Observatory and to have been deployed on the Space Station Freedom. Because of budget constraints at NASA it was never launched.

Another experimental attempt was made in 1987 by Michael Salamon and Steve Ahlen. The two flew a balloon above the stratosphere, but the balloon fell to the earth after only 12 hours of flight time. Salamon and Ahlen began building their experiment in 1984 and the results were disappointing -- they did not find any sign of cosmic antimatter, but it is possible that their experiment was not sensitive enough. Undaunted , Salamon and Ahlen are now working as collaborators on the AMS experiment.

NASA plans to fly AMS as a Space Shuttle payload on the STS-90 mission. During this flight the detector will operate for approximately 100 hours with the goal to confirm how the detector will perform under space flight conditions. Currently the plan for the second space flight mission in 2001 is to install it on the space station as an attached payload. The experiment will run for three years before it is returned to Earth on the shuttle. This will give the AMS Collaboration the time they need to gather the data required to accomplish their objectives.

The magnet, which will weigh in at 2 tons and have 64 premagnetized pieces, will use neodymium boron iron from China. China produces about 90% of the world's supply of neodymium boron iron and the highest grade will make the astrophysics detector possible. Neodymium boron iron is not available commercially and is provided through arrangements with the Chinese Academy of Science. Three tons will actually be produced with one ton to spare (see Figure 2).

The collaboration has international partners from 37 universities and laboratories. Scientists from China, Finland, Germany, Italy, Russia, Switzerland, and Taiwan are participating in the collaboration. In January 1996, Vice President Al Gore and Prime Minister Viktor Chernomyrdin announced a Joint Statement on the US/Russian Cooperation in Developing the Alpha Magnetic Spectrometer. This statement confirmed that Russian scientists and specialists will have an active part in modeling and manufacturing of experimental samples of individual blocks of the spectrometer and in developing other instruments such as the transition radiation detector.

In addition to MIT, the US participants are from Boston University, California Institute of Technology, Goddard Space Flight Center, Howard University, Johns Hopkins University, Louisiana State University, University of Maryland, Southern University, and University of Utah. Many of the scientists involved with this collaboration have been working together over the last sixteen years on the L3 experiment.

No cosmic ray experiment has ever been done which was sensitive enough to sample cosmic rays which come from other galaxies. The scientific questions remain. Some theorists believe that antimatter does not exist in appreciable quantities in the universe, but Ting and his collaborators continue to push forward anticipating precise measurements of anti-protons and anti-nuclei from unexplored areas of the universe.

References

1. Dirac, P.A.M., Nobel Lecture, "Theory of electrons ad positrons," December 12, 1933.
2. Taubes, Gary, "The Anti ± Matter Mission," **Discover**, April 1996, p. 73-79.
3. Ting, Samuel, et al, "Physics of EMI - Group," April 1995.
4. Ting, Samuel, et al, "Physics of EMI - Group," April 1996
5. The Antimatter Spectrometer Experiment Description.

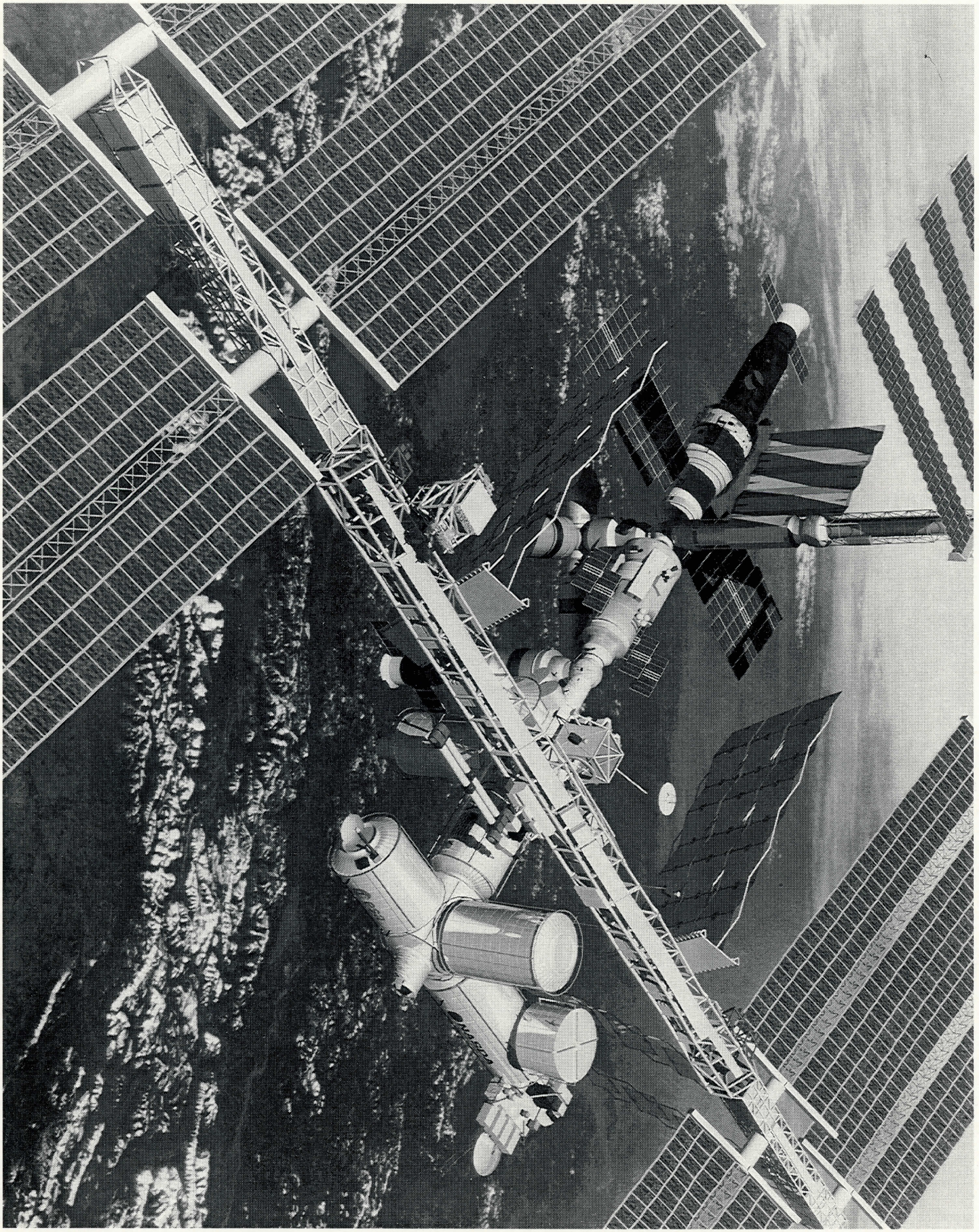


Figure 2: Location of AMS on the International Space Station Alpha

LNS Publications

Nuclear Interactions Group

"Recoil Proton Spin Polarization and Out-of-Plane structure Functions in Electron-Proton Coincidence Measurements at Bates: A Progress Report," W. Bertozzi, LNS-96-163.

Center for Theoretical Physics

"Another View on Massless Matter-Gravity Fields in Two Dimensions," R. Jackiw, LNS-96-164, CTP #2377.

"Heavy Meson Electromagnetic Mass Differences from QCD," Markus A. Luty, LNS-96-165, CTP #2412.

"String-Inspired Gravity with Interacting Point Particles," Dongsu Bak and Domenico Seminara, LNS-96-166, CTP #2431.

"Vassiliev Invariants for Tours Knots," M. Alvarez and J.M.F. Labastida, LNS-96-167, CTP #2434.

"Physical States in Matter-Coupled Dilaton Gravity," D. Cangemi, R. Jackiw and B. Zwiebach, LNS-96-168, CTP #2436.

"Varieties of Vacua in Classical Supersymmetric Gauge Theories," Markus A. Luty and Washington Taylor, LNS-96-169, CTP #2440.

"Averaged Energy Conditions and Evaporating Black Holes," L.H. Ford and Thomas A. Roman, LNS-96-170, CTP #2446.

"Quantum Gravity Effects at a Black Hole Horizon," Gilad Lifschytz and Miguel Ortiz, LNS-96-171, CTP #2449.

"Time-Dependent Quantum Scattering in 2+1 Dimensional Gravity," M. Alvarez et al, LNS-96-172, CTP #2451.

"Chronological Inversion Method for the Dirac Matrix in Hybrid Monte Carlo", R.Brower et al, LNS-96-173, CTP #2461.

"Area Preserving Diffeomorphisms and 2-d Gravity," HoSeong La, LNS-96-174, CTP #2462.

"Challenging Weak Scale Supersymmetry at Colliders," Greg W. Anderson and Diego J. Castaño, LNS-96-175, CTP #2464.

"A Geometric Approach to Free Variable Loop Equations in Discretized Theories of 2D Gravity," Sean Carroll, et al, LNS-96-176, CTP #2465.

"Gluon Spin in the Nucleon," R. L. Jaffe, LNS-96-177, CTP #2466.

"Polarizabilities of Gluon Fields in a Polarized Nucleon," Xiangdong Ji, LNS-96-178, CTP #2468.

"Energy-Momentum Tensor Improvements in Two Dimensions," S. Deser and R. Jackiw, LNS-96-179, CTP #2469.

"Operator Expansion for High-Energy Scattering," I. Balitsky, LNS-96-180, CTP #2470.

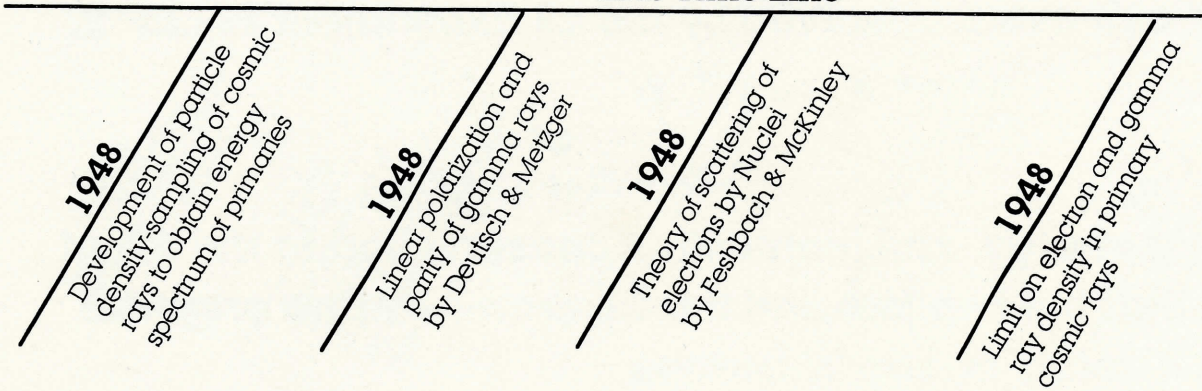
"String Center of Mass Operator and Its Effect on BRST Cohomology," LNS-96-181, CTP #2471.

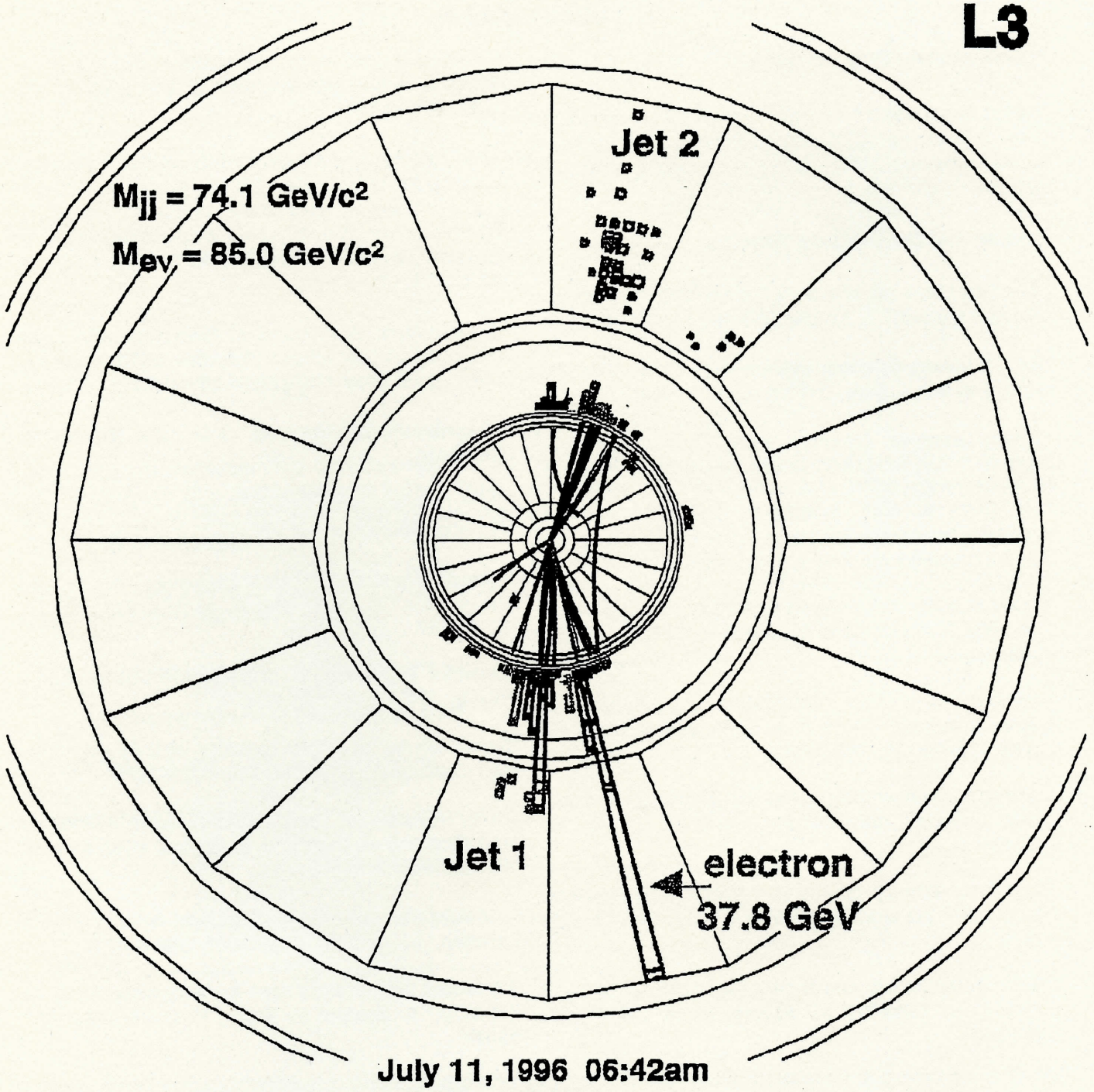
"Parity Violation in Quasielastic Electron Scattering from Closed-shell Nuclei," J. E. Amaro, et al, LNS-96-182, CTP #2472.

"Calculation of the Aharonov-Bohm Wave Function," M. Alvarez, LNS-96-183, CTP #2473.

"Threshold Singularities and the Magnetic Mass in Hot QCD," R. Jackiw, So Young Pi, LNS-96-184, CTP #2479.

LNS Time Line



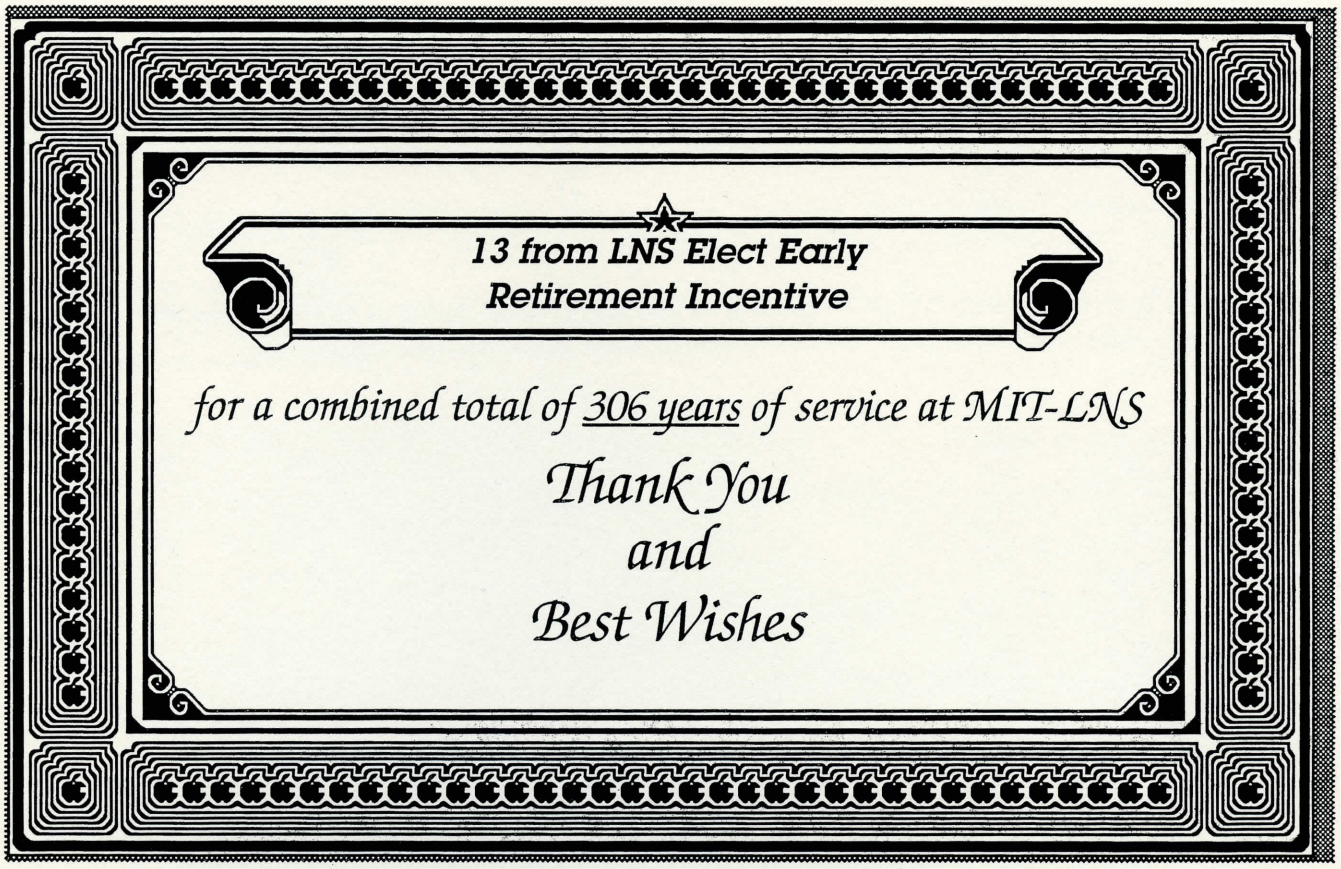


First W pair event observed by the L3 Experiment at LEP 2.

$$e^+ e^- \rightarrow W^+ W^-$$
$$\hookrightarrow e^- \bar{\nu}$$
$$\hookrightarrow \text{jet} + \text{jet}$$

Applying energy and momentum conservation to the event shows that the two jets and the electron-neutrino originate from the decay of two W bosons.

y96527Wevent



	At MIT Since
J. Robert Byrda - General Services	7/26/73
Les Cole - Bates	10/21/75
Ragnhild Gundersen - APC Group	9/29/61
Mary Hogan - Fiscal Office	2/28/80
Audrey Iarocci - Bates	2/8/82
David McCurley - Mech. Engineering	1/9/78
Thomas Provost - Bates	6/15/64

	At MIT Since
Toivo Rannikko - Bates	6/11/79
Wade Sapp - Bates	5/1/78
George Sechen - Medium Energy and Nuclear Interactions Groups	7/2/56
Ronald St. Jean - Machine Shop	5/29/67
Nagel Stone - Machine Shop	12/19/66
Emanuel Zalejko - Machine Shop	2/4/80

LNS Time Line

1949 Effective range theory by Blatt & Jackson

1949 First experimental evidence of $\pi 0$ from cloud chamber data of cosmic radiation by Gregory, Rossi & Tinlot

1950 Nuclear magnetic moments by angular correlation

1950 MIT 300 MeV synchrotron operational

1950 Measurement of mean life of $\pi+$ at MIT synchroton by Kraushaar, Henri & Thomas

Bottom Line
"Do Not Use the Elevators In Case of Fire"

In case of fire, occupants of all buildings should proceed to the nearest exit and do not use the elevators.

If you are interested in seeing a demonstration on how to use a fire extinguisher, please contact Dick Adams, the LNS Safety Officer at 3-2362 or adams@mitlns.mit.edu.

Bottom Line is an opportunity for you to share your issues, questions, points of view and opinions with the LNS community. *Pulse reserves the right to edit articles and to refuse articles deemed inappropriate.*

LNS Holiday Reception

This year the LNS holiday reception will be at the New England Aquarium on December 8, from 3:00 PM - 6:00 PM

Welcome

Xudong Cai - Postdoctoral Assoc. L3

Peter Goodwin - Sr. Tech (Mech) from Magnet Lab.

Jannine Peruffo - Receptionist at Bates

William Schmitt - Postdoctoral Assoc. Medium Energy Group

Martin Stock - Sr. Secretary, CTP

Promotions

Virginia Bullard - Promoted to Sr. Secretary at Bates

James Coyne - Promoted to Sr. Tech (E-M)

Eugene Foti - Promoted to Sr. Tech (E-M)

Larry Longcoy - Promoted to Chief Operator at Bates

Anne Maloney - Promoted to Sr. Stk. Clerk "AA"

Scott Ottaway - Promoted to Proj. Tech (E-M)

David Scoggins - Promoted to Proj. Tech (Electrical)

Departures

Brant Binns - Bates, 7/3/96

Denise Cormier - CTP, 2/9/96

James E. De Cobert - Bates, 1/31/96

Umberto Fazio - Machine Shop, 6/14/96

Frank Hills - Bates, 2/16/96

Lawrence O'Brien - Bates, 3/16/96

John Ryan - PPC Group, 1/31/96

Scott van Verst - Nuclear Interactions Group, 2/19/96

THE PULSE is a publication of the Laboratory for Nuclear Science for the LNS Community.

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If you have any ideas and/or suggestions for new features in THE PULSE please let us know. Address inquiries to Pulse, 26-537.

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http://mitlns.mit.edu/~elsye/pulse.html