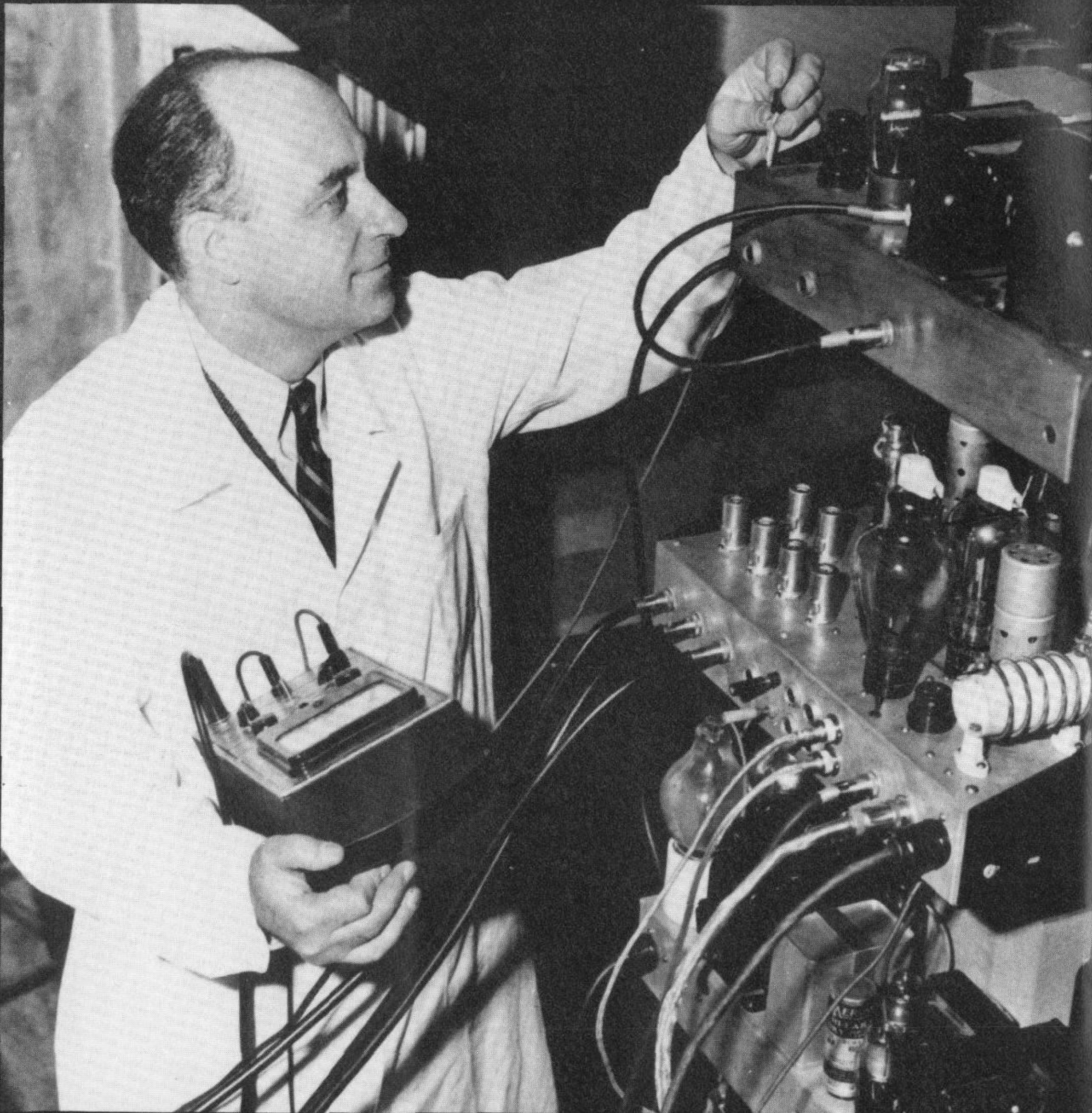
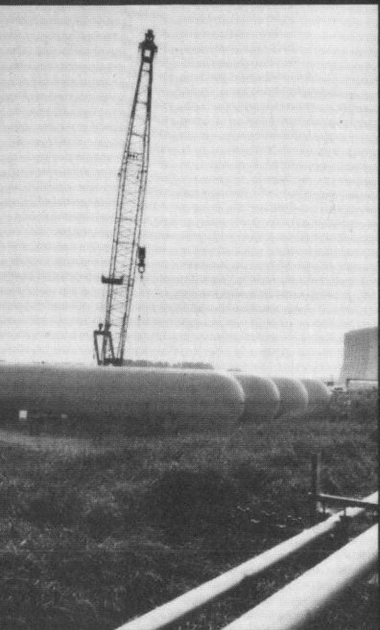
# Dedication of the Energy Saver

Fermi National Accelerator Laboratory April 28, 1984



Enrico Fermi (1901-1954)

Robert R. Wilson, Director Emeritus




MUST

# THE ENERGY SAVER

On July 3, 1983, at 3:37 p.m., the Fermilab Energy Saver first accelerated protons to an energy of 512 billion electron volts (GeV). On February 16, 1984, an energy of 800 GeV was achieved and extracted to the experimental areas. The world's first superconducting* accelerator went into operation after six years of R&D and four years of combined R&D and construction.

Two objectives were served by the construction of the Energy Saver. As the name suggests, the power consumed by a superconducting accelerator with its associated refrigeration is far less than that which a conventional accelerator uses. Moreover, the superconducting magnets can reach much stronger magnetic fields, permitting acceleration to 1000 GeV in the same tunnel as the original 400-GeV facility.

The scientific issues, foreseen dimly in the mid-70s, have now developed in such a manner as to justify the effort, far beyond original expectations; there is now promise of incisive data over a large and important domain of parameters.

The technological success of assembling and operating a four-mile-long ring of superconducting magnets together with a complex cryogenic system of unprecedented scale provides world-wide encouragement for the future of particle physics.

*A "Primer on Superconductivity" appears later in this program.

## EXHIBITION OF ENERGY SAVER TECHNOLOGY

*(This exhibit will be on display in Wilson Hall, 15th floor, until May 27, 1984)*

### Exhibitors

Hewlett Packard
IBM
Ideal Tool
Intermagnetic General Corporation
Kinetic Systems
Magnetic Corporation of America
Meyer Tool
New England Electric Wire
Omnibyte Corporation
Tektronix
Tool & Die Institute
Union Carbide Corporation

## ART EXHIBIT IN HONOR OF THE ENERGY SAVER DEDICATION

*(This exhibit will be on display in Wilson Hall, 2nd floor gallery, until May 27, 1984)*

### Exhibitors

Clayton Bailey
Charles Derer
Ed Dietrich
John Hubbard
John David Mooney
Lawrence Price
Tom Scarff

# DEDICATION PROGRAM
# RAMSEY AUDITORIUM

| | | |
|---|---|---|
| Prelude: | *"Abstract"* and *"Proposal"* | Music synthesis by Walter Kissel |
| Chair: | H. Guyford Stever | President, Universities Research Association, Inc. |
| Speakers: | Leon M. Lederman | Director, Fermilab |
| | Charles H. Percy | Senior Senator, Illinois |
| | James R. Thompson | Governor, State of Illinois |
| | John T. Meyers | Congressman, Indiana, Ranking Minority Member Subcommittee on Energy and Water Development |
| | George A. Keyworth | Science Advisor to the President and Director, Office of Science & Technology Policy |
| Address: | Danny J. Boggs | Deputy Secretary of Energy |

Videotape: "Construction of the Energy Saver"
Background Music: *"Continuity,"* music synthesis

| | | |
|---|---|---|
| Platform Group: | J. Ritchie Orr | Head, Energy Saver |
| | Helen Edwards | Deputy Head, Energy Saver |
| | Richard Lundy | Head, Superconducting Magnet Facility |
| | Robert R. Wilson | Director Emeritus, Fermilab |
| | David Saxon | Chairman of Corp., MIT |
| | Edward Knapp | Director, NSF |
| | Alvin Trivelpiece | Director, Energy Research Department of Energy |
| | Hilary Rauch | Manager, DOE Chicago Operations Office |
| Postlude: | *"Celebration"* | Music synthesis by Walter Kissel |

# ENERGY SAVER CHRONOLOGY

| | |
|---|---|
| March 1971 | Robert R. Wilson announces intention to request authorization to build Energy Saver |
| Sept. 1972 | Working group established |
| Jan. 1973 | R&D started |
| April 1973 | First short magnet tested |
| May 1973 | First preliminary design report |
| Jan. 1974 | Energy Doubler Design Study Progress Report |
| May 1975 | Beam transported through one 3-ft magnet at B12. Magnet hung on tunnel ceiling |
| July 1975 | Central Helium Liquefier Satellite concept developed |
| Aug. 1975 | Beam quench studies on early superconducting magnet in A0 extraction line |
| Dec. 1975 | External collar concept developed |
| Feb. 1976 | B12 above-ground test area started |
| 1976 | About ten 22-ft magnets made |
| Dec. 1978 | Beam transported A0 to A17, 22-ft magnets (20 dipoles, 3 quads) |
| May 1979 | Final design report--change magnet design length to 21 ft |
| June 1979 | B12 test area--16 22-ft magnets, 4 quads installed |
| July 1979 | Start of construction |
| Dec. 1980 | Start installation of A-sector |
| Jan. 1981 | B12 test area--16 21-ft magnets, 4 quads, installation starts |
| March 1981 | B12 test area--start tests on final magnets |
| May 1981 | Installation of 3/4 A-sector |
| Jan. 1982 | 3/4 A-sector test to 4200 A |
| March 1983 | Last magnet installed in ring |
| May 1983 | Entire accelerator cooled to liquid helium temperature |
| June 2, 1983 | First full turn of beam around machine |
| July 3, 1983 | Acceleration to 512 GeV |
| Aug. 2, 1983 | Extraction to Experimental Areas |
| Aug. 15, 1983 | Acceleration to 700 GeV |
| Oct. 1, 1983 | Begin Physics Program |
| Oct. 16, 1983 | Beam storage for over 30 hours |
| Feb. 14, 1984 | First running period terminated |
| Feb. 16, 1984 | Acceleration and extraction at 800 GeV |
| Mar. 17, 1984 | Begin 800-GeV experimental program |
| April 4, 1984 | 800-GeV protons delivered to seven target stations |

# PRIMER ON SUPERCONDUCTIVITY

Superconductivity is a physical phenomenon exhibited by certain metals and alloys at very low temperature. In 1911, the Dutch physicist Kammerlingh Onnes found experimentally that the electrical resistance of certain elements becomes too small to measure when they are cooled to very low temperature. "Superconductivity" exists only within certain limits of temperature, magnetic field, and current density; as soon as any one of these exceeds a critical level, superconductivity vanishes and normal resistance resumes.

If a wire of niobium-titanium alloy, today's most common superconductor and the one used in the Fermilab Energy Saver magnets, is cooled, the wire's electrical resistance declines steadily, just as it would with a conventional conductor like copper. Then, at about 10 degrees above absolute zero (10 Kelvin or 263°C below zero), the resistance abruptly vanishes, and the wire has entered the superconducting state. At this critical temperature even a tiny current or magnetic field applied to the superconductor will return it to the resistive state, an event called "going normal." Cooled further, the NbTi tolerates increasingly large currents and fields without going normal. In a magnet, this process is called "quenching." At 4.2K, the Energy Saver conductor has a field and current limit of 5T and $2\times10^5$ amperes per square centimeter.

The value of superconductors lies in their ability to transmit huge currents without electrical resistance, and thus sustain intense and extremely steady magnetic fields. These characteristics have prompted many application ideas with possible long-range commercial significance. Some possible uses of superconductivity are in fusion devices, in medical imaging via NMR devices, in experimental levitated trains, in electrical transmission lines and in energy-storage devices. In the course of the R&D program to develop the superconducting magnets for the Energy Saver, Fermilab played a very prominent role in stimulating industry to develop its superconductivity skills. Approximately 150,000 pounds of a once-exotic niobium-titanium superconducting alloy was used in creating the Saver.

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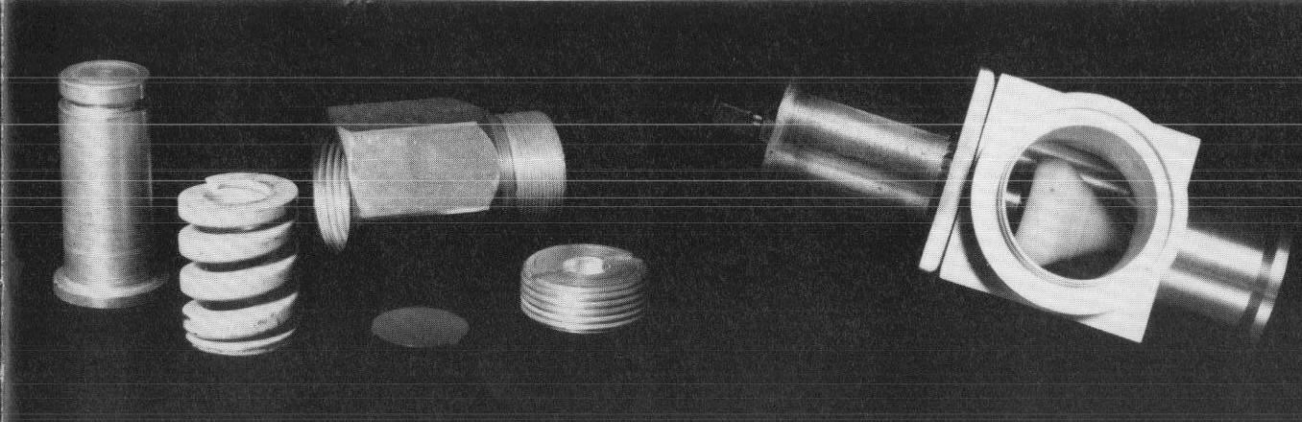

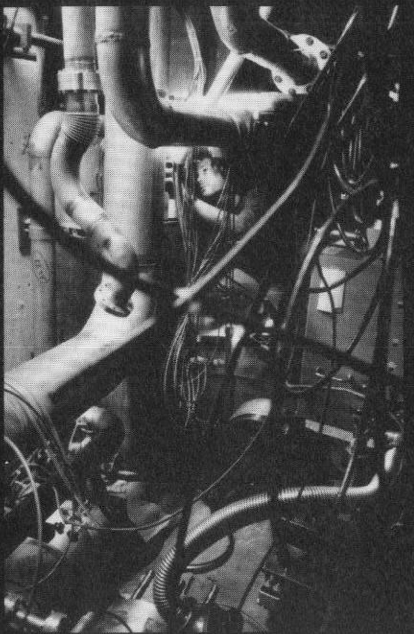

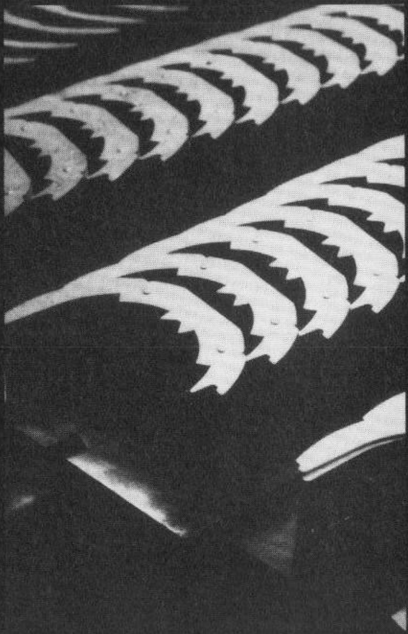

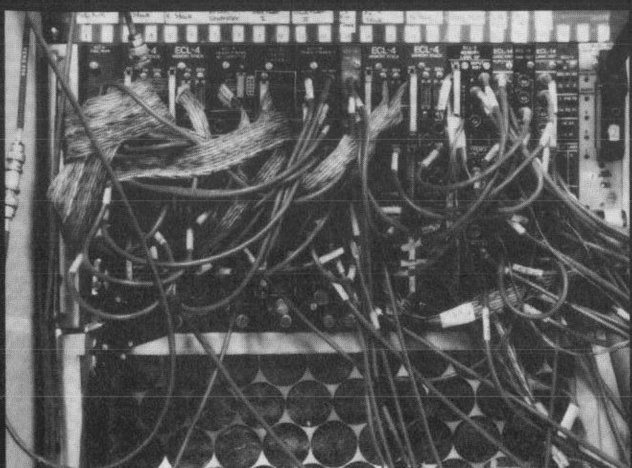
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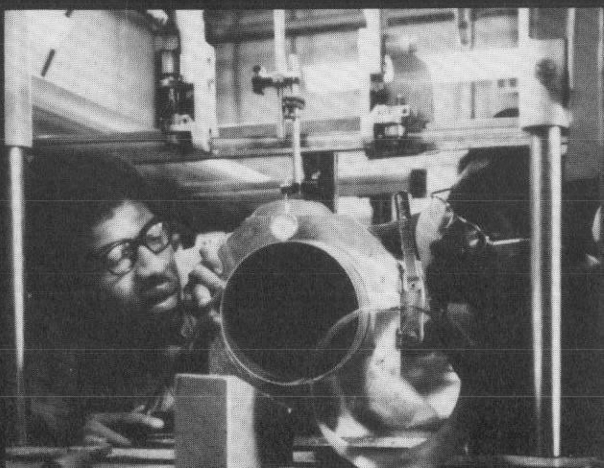

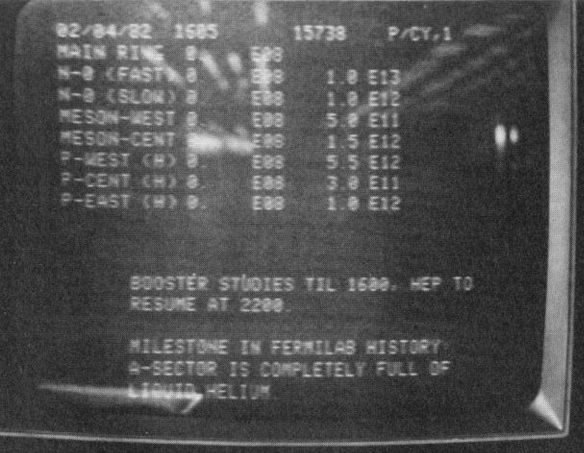
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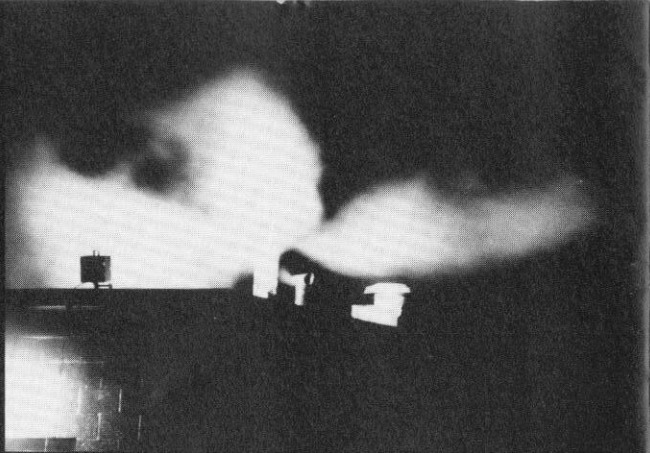
P-WEST (H) 0. E08 5.5 E12
P-CENT (H) 0. E08 3.0 E11
P-EAST (H) 0. E08 1.0 E12
BOOSTER STUDIES TIL 1600. HEP TO
RESUME AT 2200.
MILESTONE IN FERMILAB HISTORY:
A-SECTOR IS COMPLETELY FULL OF
LIQUID HELIUM.

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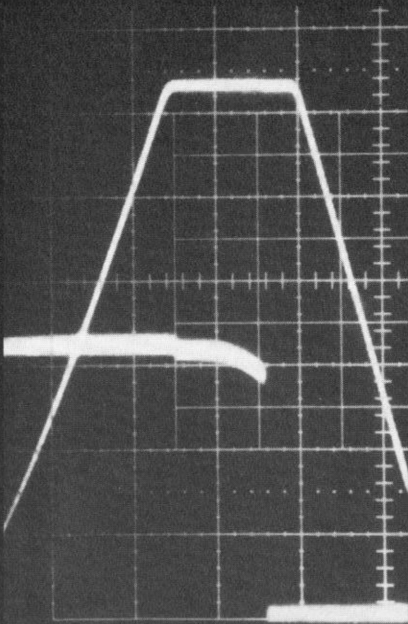
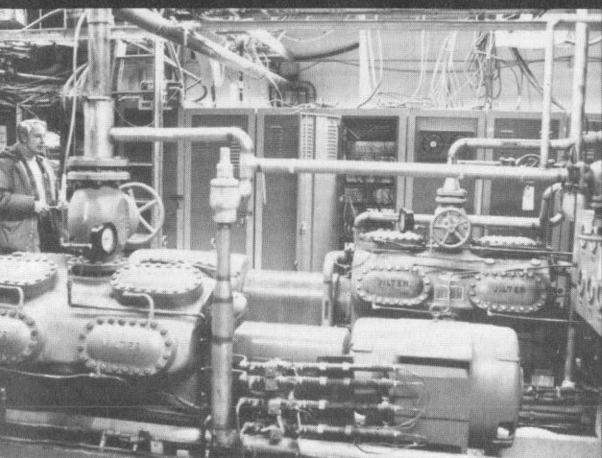
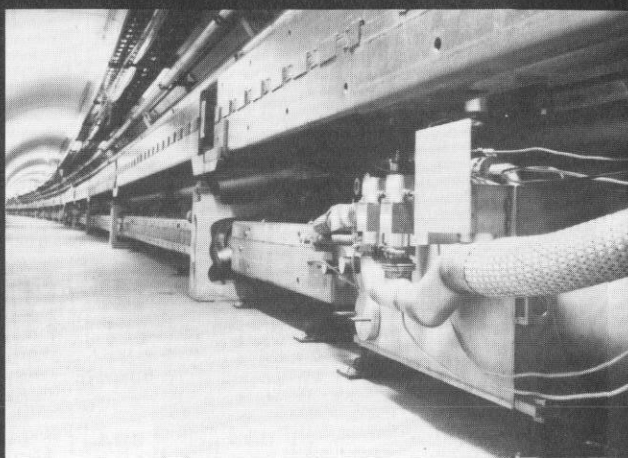
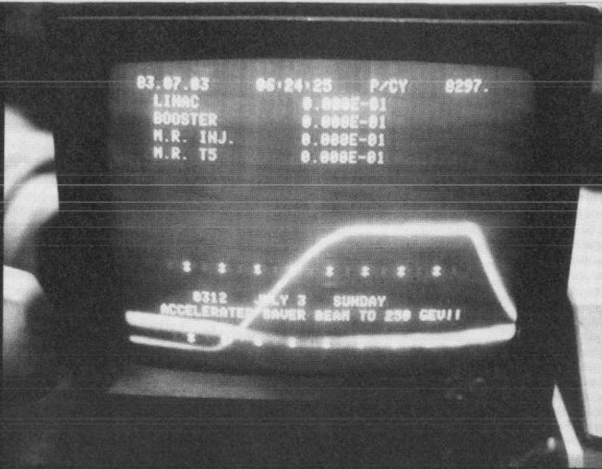
REFRIGERATOR





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LINAC 0.000E-01
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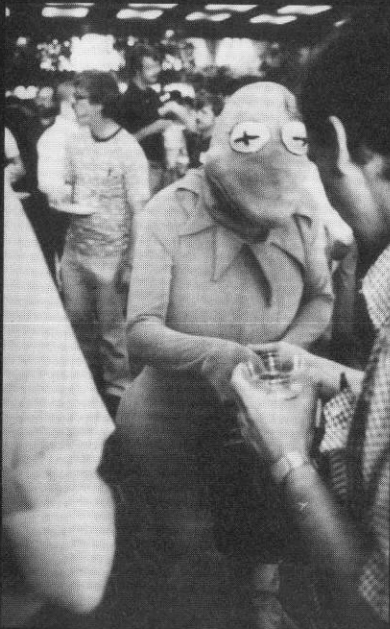
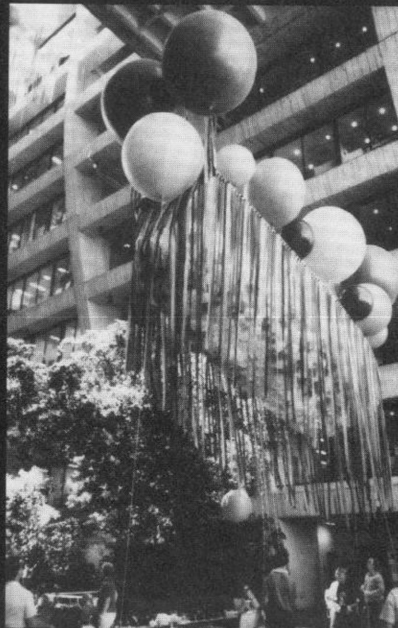
0312 JULY 3 SUNDAY
ACCELERATED SAVER BEAM TO 250 GEV!!





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