

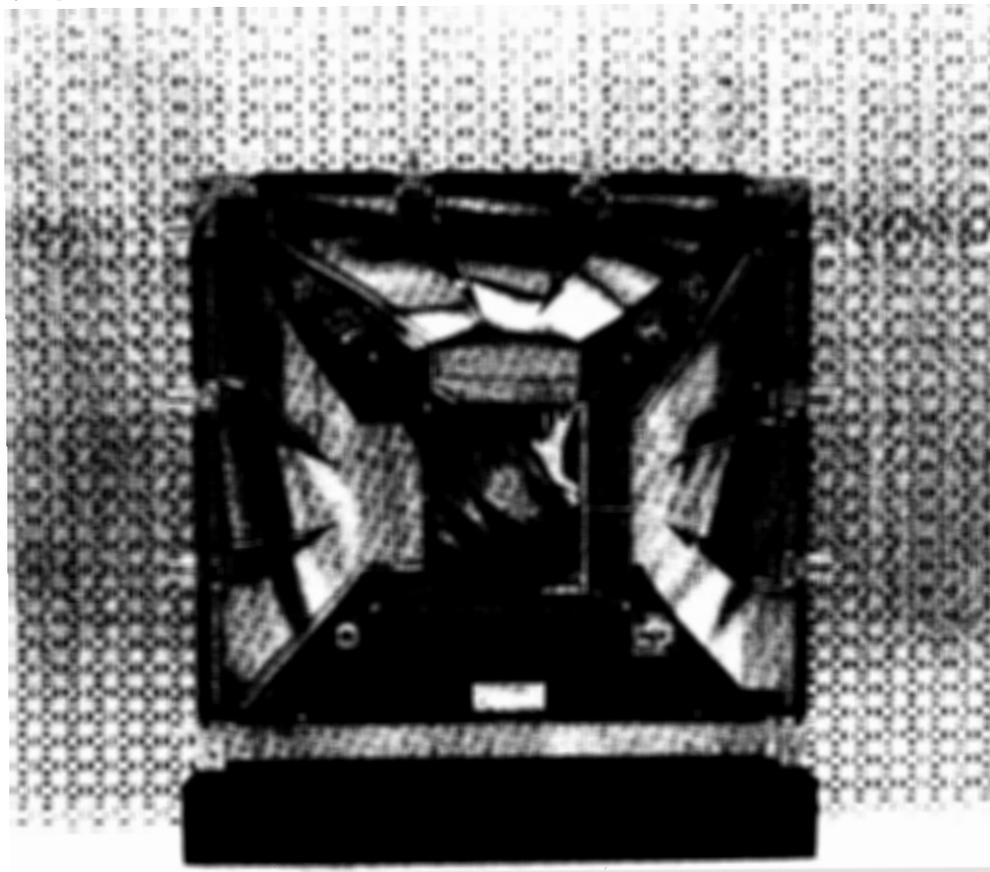
# fermilab report



Fermi National Accelerator Laboratory Monthly Report

April

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FERMILAB-86/4



Fermi National Accelerator Laboratory

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***THE COVER:** Pictured is a triplet (3 planes) of silicon microstrip detectors for Experiment 687, a study of photoproduction of particles containing heavy (charm and bottom) quarks. This experiment is presently being built in the new Wide Band Photon Lab by a team of scientists from Colorado, Fermilab, Frascati, Illinois, Milano, Northwestern, and Notre Dame. A total of 12 planes, 8256 individual detector elements, forms the high resolution vertex detector which, along with a powerful new multiparticle spectrometer, will detect and study the decays of heavy quark states. The pitch (transverse size) of the silicon detector elements varies from 25 to 50 to 100 microns width, depending on the longitudinal distance from the active silicon wafer target and the transverse distance from the photon beam.*

*(Fermilab photograph 86-254-1)*

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CONFERENCE ON THE TEACHING OF MODERN PHYSICS  
Fermilab, April 24 - 27, 1986

Stanka Jovanovic

Dear Dr. Lederman,

*I have reached home, but am not the same. I have been to a mountain-top experience in the Conference on the Teaching of Modern Physics. It is a rare experience for a teacher to be permitted to associate with the recognized leadership of a field, indeed set of fields, and feel no fear of appearing 'ignorant'. On top of that, to be meeting in one of the premier facilities of science compounds the feeling of respect and privilege to be one of those studying physics, and striving to teach the subject.*

*I love teaching, but need to be fed myself. That is what this session has done for me. I know that my courses will be different, starting tomorrow morning. The details unknown, the general outlines are in place.*

*- Conference Participant  
April 27, 1986*

These words reflect the feeling of 135 high school and college teachers who participated in the Conference on the Teaching of Modern Physics held at Fermilab from April 24 to April 27, 1986. This is the second in a series sponsored by the International Commission on Physics Education (ICPE). The first was held at CERN in 1984. The Fermilab meeting was co-sponsored by the American Association of Physics Teachers (AAPT). The teachers, who hailed from all over the United States and Canada as well as Latin America, spent four days at the Lab in intensive preparation of curriculum materials in particle physics and cosmology. These are the first topics to be tackled in an effort to bring modern physics into the high school and freshman college physics classroom.

The conference was carefully designed and structured to allow a continuous flow of written materials, first into the hands of "editors," then to word processing personnel, and thence directly to the copying machines. This monumental task, successfully accomplished, enabled the participants to return home with an over 170-page manuscript ready to use and test in their classrooms.

Topic lectures were given by leaders in the field (see program listing on page 9). These lectures were designed to serve as course material for the developing curriculum. Following each lecture, participants were divided into five working groups. Each group was led by a high school "master" physics teacher together with a Fermilab physicist. After a short review, each group divided into "color" groups of 3 or 4 people. Each color group was responsible for developing specific

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materials for lectures (blue), labs (pink), demonstrations (yellow), problems (tan), test questions (red), and audiovisuals (green). Samples of these are reproduced below and on the following three pages.

Conference on the Teaching of Modern Physics  
Fermilab - April 24-27, 1986

DRAFT -04/26/86  
AudioVisuals

### GUTS

1. "Scatter" by CONDUIT is a computer program that allows the student to "shoot" particles at various targets. Students must then, by viewing the resulting tracks, determine the nature of the target.
2. Particle Formation Game - 2 parts
  - a. The computer would specify a hadron; students would then be required to "construct" it from the correct quarks. The computer will provide feedback as to the correctness of the response.
  - b. Students will assemble quarks and specify resulting quantum numbers. The computer will check for the possible existence of the particle and provide feedback. The computer keeps a record of all student attempts.
3. Interaction of particles

The computer will "show" two particles interacting. Students will have to determine the resulting particles based on the computer generated tracks of the products (i.e. a computer generated bubble chamber photo.)

The computer will keep track of all attempts.

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GUTS

2. Construct the following hadrons using  $u, d, s, \bar{u}, \bar{d}, \bar{s}$ .

Particle	Spin	Baryon number	Q	s Strangeness
$\bar{u}^+$		-1	+1	+3
$\bar{u}^-$		+1	-1	-3
$\Lambda^0$		+1	-1	-1
K-		0	-1	-1
$\Sigma^-$		+1	-1	-1
$\Xi^0$		+1	0	-2
$\Sigma^+$		+1	+1	-1

GUTS

Create a "game" for students

List the properties of constituents and list the operations allowed for elementary particles.

[Ask students to determine all possible results of allowed operations acting on each constituent.]

For this we need to have described for us:

The properties of the constituents

The allowable transformations

The hypothesized mechanisms causing transformations

## GENERAL RELATIVITY

### LAB EXPERIMENT

1. Obtain a rubber sheet from a science supply house.
2. Attach the rubber sheet to an appropriate size wooden frame, snugly attached but not drawn too tightly.
3. To the bottom of the rubber sheet glue a cup hook (plastic). The cup hook will be used to attach weights of different value.
4. Mark the rubber sheet as shown in the accompanying diagram. Add reference circle (centered above cup hook) and Newtonian paths of light.

### PART 1

1. Use the "Refraction of Particles" launcher from PSSC Physics materials to launch a marble with uniform speed.
2. Without a weight attached to the hook located beneath the rubber sheet, launch a marble along each of the separate lines of flight. Note that the marble follows a straight line path of flight and intersects the reference circle without deflection.

Note: Experiment with the rubber sheet beforehand to identify 3-5 values of mass that can be attached to produce varying degrees of deformation of the rubber sheet. Values will differ depending upon the strength of the sheet and mass of the launching marble.

3. Attach the smallest weight to the cup hook. Launch the marble along each of the Newtonian paths of flight.
4. Measure the angular deflection of each Relativistic path of flight from the Newtonian path. Record values. Linear deflection can be measured in physical science classes.

### PART II

1. Repeat steps 3 & 4, increasing the mass attached to the cup hook up to the maximum "appropriate value".
-

SYMMETRY

1. Should be introduced in the earlier part of year and used throughout the year.
  2. Problems should be developed that use a symmetric solution to a problem after the conventional method has been demonstrated.
  3. A statement of objective should be developed in terms of what could/should be said about symmetry.
  4. A relationship between symmetry and the conservation laws should/could be addressed.
  5. Definite examples should be included of problems involving symmetries
    - examples: - Gauss' Laws
      - gravitational examples/electrostatics
      - cube of resistors
      - isotropic properties of crystalline solids  
(resistivity, elasticity, etc)
      - magnetic fields
      - spherical symmetry of fire works
-

When the first typed drafts of the material became available, groups of the same color worked together to edit the materials for final production.

How could this have been achieved with 135 physicists and physics educators, most of whom had never met before? Easy! The common drive to bring modern physics topics into the classroom produced an extraordinarily creative working atmosphere. The conference format was meticulously planned ahead of time by the organizers, Fermilab physicists, and the leaders of the five teachers' working groups.

Special attention was also given to "Innovative Ideas in Teaching Modern Physics" in a roundtable presentation by Isaac Halpern (University of Washington) and Peter Lindenfeld (Rutgers University), with textbook authors Joseph Priest (Miami University), Robert Resnick (Rensselaer Polytechnic Institute), Raymond Serway (James Madison University), and Frederick Trinklein (Long Island Lutheran High School). Several ideas came forth on how to overcome the long time between textbook revisions relative to the rapid developments in modern physics, such as:

- . Do not wait for textbook revisions; "sprinkle" modern physics throughout the present course. Materials developed at the conference are ideal for just that purpose.
- . A series of seminars on topics in modern physics throughout the school year.
- . A 1-credit "dessert" course without exam is another way to attract large numbers of students.

All agreed that it is most important to keep students and teachers informed on current developments in science through conferences such as this, through seminars, summer job programs, research participation projects, and through media.

E. Leonard Jossem of Ohio State University, and Secretary of ICPE, presented an overview of what the rest of the world is doing about physics education. It is evident that concerns in regard to the teaching of physics are universal.

In addition to ICPE and AAPT, the meeting was co-sponsored by Fermilab and the Friends of Fermilab Association (FFLA). Gordon Aubrecht (AAPT), and Drasko Jovanovic and Judy Zielinski (Fermilab) were instrumental in organizing and administering the conference. The conference was moderated by Marjorie Bardeen, FFLA Program Director.

The group leaders, all of whom are physics teachers from Illinois schools, were Walter P. Schearer (Glenbard North High School), James Ruebush (St. Charles High School), William K. Conway (Lake Forest High School), JoAnn Johnson (Wheaton North

High School), and Ward Haselhorst (Proviso East High School). Fermilab physicists Charles Brown, Richard Carrigan, Jr., Chris Hill, Carlos Hojvat, Richard Holman, Rolland Johnson, Leo Michelotti, Stephen Parke, Stephen Pordes, Chris Quigg, Terry Walker, and David Brown of Harvard University were the "physics resources" for the group sessions. Marilyn Smith, conference secretary, assisted by Pat Hatcher, Lisa Lopez, Gladys Pool, and Eva Williams, completed a mountain of typing. In the end, many willing hands assisted with the duplicating and collating of the conference materials.

Funding for the conference was provided by the National Science Foundation, and by sponsorship through the Friends of Fermilab Association by George J. Ball, Inc., W.W. Grainger, Inc., The Brooks and Hope B. McCormick Foundation, and Albert H. Ramp, Architects/Engineers, Inc.

This is not the end of this endeavor. The conference will reconvene in San Francisco at the January 1987 joint meeting of the APS/AAPT. By that time the participants will have tested and evaluated the materials in their classrooms, and manuscripts will be ready for final editing. Printing and national distribution by the AAPT will follow shortly after. At that point, planning for the next conference in this series will be well underway. The Conference on the Teaching of Modern Physics in Solid State Physics is scheduled to be held in Germany in 1988.

Program

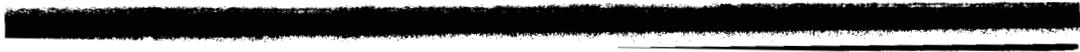
<u>Date</u>	<u>Lecturer/Affiliation</u>	<u>Topic</u>
04/24/86	Victor F. Weisskopf (MIT)	Qualitative Physics
04/24/86	Chris Quigg (Fermilab)	Discoveries, Insights, and Tools
04/24/86	Chris Hill (Fermilab)	Symmetry
04/25/86	Howard Georgi (Harvard)	Guts and Elementary Particles
04/25/86	David N. Schramm (University of Chicago)	Big Bang: Creation of the Universe
04/26/86	Clifford M. Will (Washington University)	Observational Tests of General Relativity
04/26/86	E. Leonard Jossem (Ohio State University)	International Discussions
04/27/86	Roundtable (see text)	Innovative Ideas in Teaching Modern Physics

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*A view of wire stringing operations on the CDF Central Tracking Chamber (CTC). The chamber, which contains more than 30,000 wires, was held in a horizontal position during stringing and was free to rotate on a set of motorized "wagon wheels." The CTC group includes Juan Bofill, Bill Foster, Asset Mukherjee, Bob Wagner, and group leader, Richard Kadel.*

*(Fermilab photograph 86-231-10)*



**ARLENE LENNOX NAMED ONE OF THE OUTSTANDING WOMEN LEADERS  
IN DUPAGE COUNTY, ILLINOIS**

Susan Winchester

Arlene Lennox, Deputy Department Head of the Neutron Therapy Facility, was recently named as one of the Outstanding Women Leaders of DuPage County at the Third Annual Awards Ceremony held on May 8, 1986, at the Sheraton-Naperville.

The West Suburban YWCA selects eight women each year in one of the following categories: Arts and Cultural, Athletics, Business and Professional, Community Volunteer, Education, Government and Politics, Professional in Community Work, and Science and Medicine, and an additional award is presented for Special Recognition.

Arlene, who came to Fermilab in 1974, won the award for her work in Science and Medicine. She was cited for "being instrumental in creating opportunities for high school science teachers to gain practical experience in their fields."

As noted in the program from the ceremony, Arlene was a mathematics, chemistry and physics teacher for six years before pursuing her M.S. and Ph.D. in physics. She became aware of how little access most science teachers have to current research and practice. This led to her involvement in the development of the Illinois Research Corridor Summer Jobs Program for High School Teachers, which Arlene now coordinates as a volunteer. This program provides summer employment opportunities for teachers in such diverse organizations as Fermilab, Argonne, NALCO Chemical, and George J. Ball. The program currently involves 10 scientifically-linked companies.

In addition to her efforts on behalf of high school science teachers, Arlene has also been active in the Summer Jobs Program for Minority Science Students and was a member of the organizing committee for that program in 1977. She has also served as a consultant to the Corridor Partnership for Excellence in Education, and has served as an Assistant Professor at North Central College.

Speaking before a crowd of over 400, including her husband, Dave Eartly, who is a physicist with the DØ project; Phil Livdahl, who is Deputy Director and Head of the Neutron Therapy Facility; Charles Rey, her thesis advisor; Margaret Pearson and Millie Heim of Public Information; and Don Young of TeV I, Arlene said, "As some of you may know, I have spent most of my professional life in what is known as a "man's field." About two weeks ago, the *Chicago Tribune* had an article on the difference in performance of men and women in such a field. They said a man's motivation is to win while a woman's motivation is quality output. Looking back over my career, I am inclined to agree with

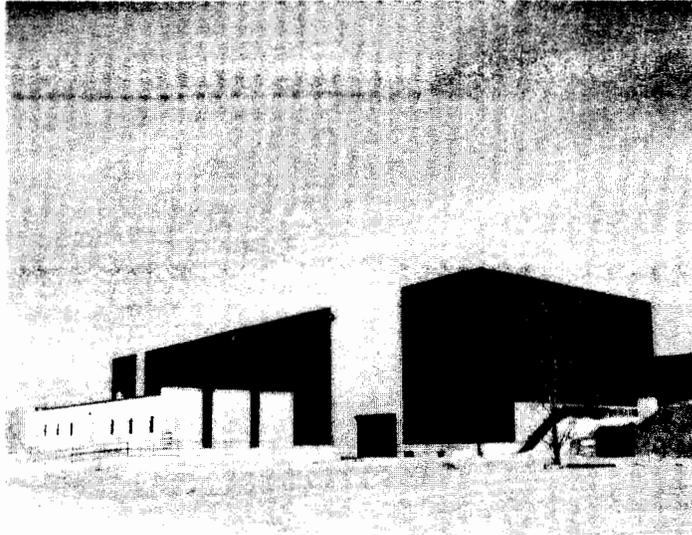
that assessment. Most of the time I did not win - at least not in the short term - but I always put out a quality product.

"The award I am receiving today is very special to me for two reasons. First, because as I perceive it, it is an award for quality output. Second, because it involves women recognizing the achievements of other women. It has been my experience that too many women have negative images of women, whether it be their own self images or their perceptions of other women. It is time to change that and this awards luncheon is a step in the right direction. Thank you."



*Arlene Lennor*

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*The M-West Experimental Hall houses the new liquid argon calorimeter for Experiment 706. The low structure adjacent to the Hall is the Counting Room.  
(Fermilab photograph 86-312-3)*

NOTES AND ANNOUNCEMENTS

Promotions...

At their recent meeting, the URA Board of Trustees approved the promotion of physicist John Marriner to Scientist I, an appointment without time limit. Marriner is a member of the Accelerator Division's Pbar Source Department. He came to Fermilab from the University of California, Berkeley, in 1978 as a Research Associate, and became an Associate Scientist in 1981.

The URA Board of Trustees also approved the promotion of physicist Keith Ellis to Scientist I. Ellis, who is in the Theoretical Physics Department, came to Fermilab as an Associate Scientist in 1984 following research positions at Imperial College, MIT, CALTECH, and Rome.

MANUSCRIPTS, NOTES, LECTURES, AND COLLOQUIA PREPARED  
OR PRESENTED FROM MARCH 24, 1986 TO MAY 18, 1986

Copies of preprints with Fermilab publication numbers can be obtained from the Publications Office or Theoretical Physics Department, 3rd floor east, Wilson Hall. Copies of some articles listed are on the reference shelf in the Fermilab library.

**Experimental Physics**

- S. I. Baker et al.  
Experiment #660                      Radiation Damage Effects in Channeling Applications (FERMILAB-Conf-86/54-E; presented at the Workshop on Relativistic Channeling, Acquafredda di Maratea, Italy, March 31-April 4, 1986.)
- F. Turkot et al.  
Experiment #735                      Studies of Beam Induced Radiation for Experiment 735 at the C0 Intersection Region and Its Effect on Detector Components (TM-1395)

**Theoretical Physics**

- H. Itoyama  
and J. Leon                      Stringy Corrections to Calabi-Yau Compactification (FERMILAB-Pub-85/183-T Revised; submitted to Phys. Rev. Lett.)
- H. Von Gersdorff et al.              Studies of the Hydrodynamic Evolution of Matter Produced in Fluctuations in  $\bar{p}p$  Collisions and in Ultra-Relativistic Nuclear Collisions (FERMILAB-Pub-86/13-T; submitted to Phys. Rev.)
- R. D. Pisarski                      Theory of Curved Paths (FERMILAB-Pub-86/24-T; submitted to Phys. Rev. Lett.)
- R. D. Pisarski                      Topologically Massive Chromodynamics at Finite Temperature (FERMILAB-Pub-86/32-T; submitted to Phys. Rev. Lett.)
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**General**

- M. Awschalom et al.      Proposal for a Proton Beam Therapy Facility (TM-1295; presented at the Medical Workshop on Accelerators for Charged-Particle Beam Therapy, Fermilab, Batavia, Illinois, January 19, 1985.)
- P. O. Mazur et al.      5-cm, No Iron SSC 6-m Dipole Test Program [TM-1387 (SSC-N-138); submitted to the ICMC/Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Massachusetts, August 12-16, 1986.]
- L. Michelotti      Introduction to the Nonlinear Dynamics Arising from Magnetic Multipoles (FERMILAB-Conf-86/30; submitted to the 1984 U.S. Summer School on High-Energy Accelerators, Fermilab, Batavia, Illinois, August 13-24, 1984.)
- A. Van Ginneken      Energy Loss and Angular Characteristics of High Energy Electromagnetic Processes (FERMILAB-Pub-86/33; submitted to Nucl. Instrum. Methods A)

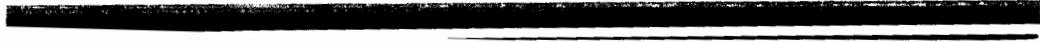
**Physics Notes**

- M. Awschalom et al.      Neutron Dosimetry: A Pin Diode Reader (FN-426)
- V. V. Avdeichikov et al.      Accelerated Beam Extraction by Means of a Bent Single Crystal at the JINR Synchrophasotron (FN-429)
- A. J. Elwyn and J. D. Cossairt      A Study of Neutron Leakage Through an Iron Shield at an Accelerator (FN-430)

**Colloquia, Lectures, and Seminars**

- J. Sexton      "QCD Radiative Corrections to Parton-Parton Scattering" (Fermilab, March 25, 1986)
- D. Harding      "Antiproton Source Machine Studies" (Fermilab, March 25, 1986)
-

J. Peoples	"Long Range R&D Plans for the Pbar Source" (Fermilab, March 27, 1986)
R. Pasquinelli	"Filters for a 4-8 GHz Stack Tail Cooling System" (Fermilab, March 27, 1986)
L. Teng	"The Argonne Synchrotron Radiation Facility" (Fermilab, April 1, 1986)
J. Griffin	"Proton RF System for HERA" (Fermilab, April 3, 1986)
J. Krider	"Performance of the Debuncher Profile Monitor" (Fermilab, April 3, 1986)
M. Harrison	"SSC Status: The Conceptual Design Report" (Fermilab, April 8, 1986)
Fermilab Workshop	"Antimatter Physics at Low Energy-Fermilab Low Energy Antiproton Facility Workshop" (Fermilab, April 9-12, 1986)
L. Michelotti	"Talmantic Commentary" (Fermilab, April 15, 1986)
P. Rapidis	"Plans for Momentum Calibration of the Debuncher and Accumulator" (Fermilab, April 17, 1986)
M. S. Turner	"Double Inflation" (Fermilab, April 21, 1986)
J. Crisp and K. Y. Ng	"Report on the Impedance Workshop for LAMPF II" (Fermilab, April 22, 1986)
H. Melanson	"Polarization of $\Lambda$ and $\bar{\Lambda}$ Produced by Protons, Anti-protons and Kaons" (Fermilab, April 25, 1986)
R. Orr	"Accelerator Division Information Meeting" (Fermilab, April 29, 1986)
F. Mills	"Bunched Beam Cooling" (Fermilab, May 1, 1986)
J. Misk	"Redesign of the Stochastic Cooling Tanks" (Fermilab, May 1, 1986)
Users Organization	"Annual Users Meeting" (Fermilab, May 2 and 3, 1986)



D. Wolff "15.8 kV Filters for the Main Ring Supply" (Fermilab, May 8, 1986)

H. Pfeffer "Modification to the Main Power Supply Planned for 1986" (Fermilab, May 8, 1986)

J. Spaulding "First Results from E-691 - Charmed Particle Photoproduction" (Fermilab, May 9, 1986)

G. Fisk et al. "Magnets, Field Quality, and Tracking - The Main Ring" (Fermilab, May 10, 1986)

M. Shea "VME Uses at CERN" and "The IBM Token Ring as Implemented on VME" (Fermilab, May 13, 1986)

W. Fowler et al. "Report of the DOE Review on the Conceptual Design of SSC" (Fermilab, May 13, 1986)

J. Krider and A. Moretti "Plans to Improve the h=84 Accumulator RF System" (Fermilab, May 15, 1986)

V. Bharadwaj "A First Look at Deceleration in the Accumulator" (Fermilab, May 15, 1986)

**DATES TO REMEMBER**

May 29 and 30, 1986	Sixth Annual Meeting of the Fermilab Industrial Affiliates
June 16-21, 1986	Extended Summer Meeting of the Physics Advisory Committee
June 23 - July 11, 1986	Summer Study on the Physics of the Superconducting Super Collider, Snowmass, Colorado; for information contact JoAnne Day, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439.
July 16-23, 1986	XXIII International Conference on High Energy Physics, Berkeley, California; for more information, please contact Susan Ovuka, Conference Secretariat, Building 80D, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720; (415) 486-6169.
October 23-29, 1986	2nd Joint US-CERN Topical Course "Frontiers of Particle Beams," South Padre Island, Texas; for information contact Marilyn Paul, Fermilab MS #125, P. O. Box 500, Batavia, Illinois 60150; (312-840-4544; FTS 370-4544)