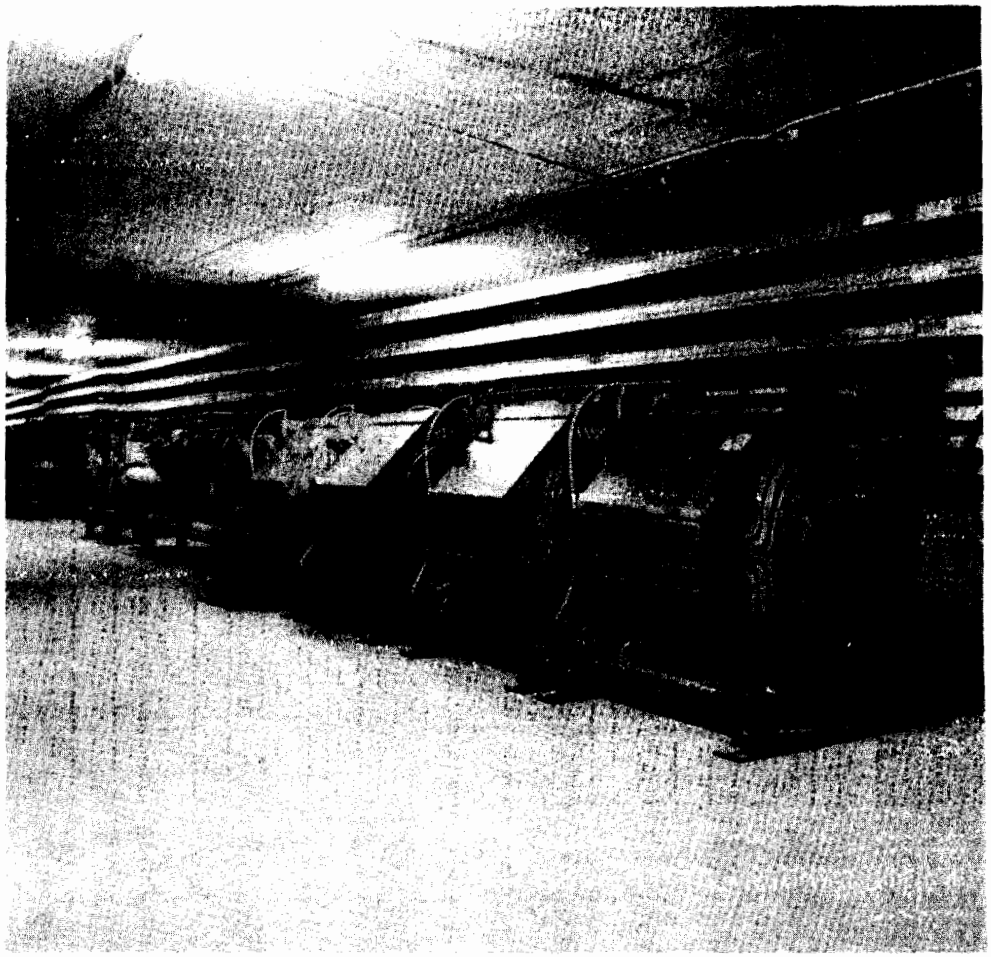
fermilab report

Fermi National Accelerator Laboratory Monthly Report

March 1985



fermilab report is published monthly by the Fermi National Accelerator Laboratory, P. O. Box 500, Batavia, Illinois 60510 U.S.A.

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FERMILAB-85/3 Fermi National Accelerator Laboratory 0090.01

THE COVER: High dispersion straight section in the Accumulator Ring. Visible are four large-aperture quadrupoles which create a "low beta, high dispersion" region for stochastic cooling pickups. One five-meter stochastic pickup tank is in position in the straight section. (Fermilab photograph 85-119-6)

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OPERATION OF THE EXPERIMENTAL AREAS

Roger Dixon

Two of Fermilab's three experimental areas, Meson and Proton, were operated for the physics program during 1984, and the third area, Neutrino, was operated primarily as a test beam area. The 1984 running was broken into two periods. The first began in October 1983 and was at 400 GeV. It was the first run of the Energy Saver. This was quickly followed by an 800-GeV run beginning in February which produced the first 800-GeV fixed-target physics data.

The physics topics addressed during the 1983-1984 runs included neutral charm production, single and pair production of hardrons and leptons, rare hyperon and kaon decays, and jet production by hadron beams. The experiments studying these issues are summarized in Table I.

In all, seven experiments took data during the year. Two of them ran only during the 400-GeV run and two ran only during the 800-GeV period. The other three took data at both energies. A total of eight groups used four test beams located in the Meson and Neutrino areas during both running periods. A summary of experiments and beam lines is shown in Table II. Experiments are designated by an E and test activities are designated by a T. In addition to the physics program, two new test beams were commissioned during the run and one new proton beam. Tests were also made on the dichromatic neutrino train.

During the 400-GeV run there were two primary users in the Meson area. The first was E-609 in the MT beam line. This experiment had taken some preliminary data during the last 400-GeV run of the conventional accelerator. The experiment was designed to study high p_t jets in proton interactions and to measure dijet cross sections. Approximately 600 hours of beam was used during the 400-GeV run to complete the experiment.

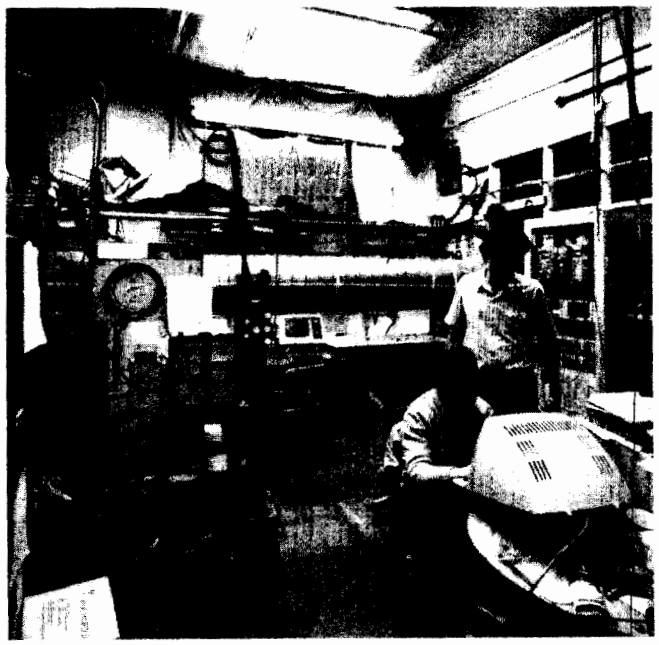
The other primary user in the Meson area was E-605. They had also taken some preliminary data in a previous run. The intent of this experiment is to study lepton and hadron production, both pairs and singles, near the kinematic limits. The experiment also measures the A dependences of these interactions. Experiment 605 ran during both runs of the accelerator accumulating approximately 550 hours of beam at 400 GeV and 700 hours at 800 GeV. Both E-605 and E-609 were hindered during their data-taking runs by the start-up reliability of the Meson beam-line cryogenic systems.

The Neutrino area was used primarily as a test beam area during the 1984 runs. The big user in the old Muon Laboratory (NWA) was E-741, better known as the Collider Detector Facility (CDF). They began a program of calorimeter calibration for the

CDF central detector. Before this program is over, each of the wedges that make up the central electromagnetic and hadron calorimeters will be fully calibrated in the test beam. Other parasitic users in NWA included the D0 collider detector group (E-740), a future fixed-target muon scattering experiment (E-665), and a tagged photon experiment (E-691) that will run in the Tagged Photon Laboratory during 1985.

Another major activity carried out in the Neutrino area was the testing of the dichromatic neutrino train. The testing was necessary to complete the design of the particle identification of the train, which will not be used until the 1986 running period. The tests were successful.

During 1984, a new test beam was constructed in the Neutrino area to serve the two large detectors in Lab C and Lab E. The beam, which is designated NT, is really two beams which branch to serve E-733 (Lab C) and E-744 (Lab E). The beam was commissioned late in the 800-GeV period, allowing both groups to calibrate their detectors in preparation for the 1985 data runs. The construction of the NT beam line was part of a larger project which included the NE beam line. The latter will provide machine energy protons to Lab G and Lab D beginning in the 1985 period.

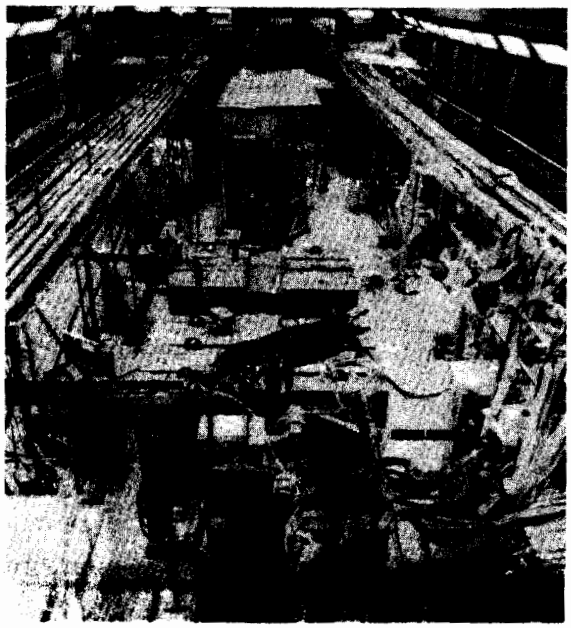


Testing a ring imaging Cherenkov counter for E-665 in the NW test beam. The counter is the large cylinder in the background.
(Fermilab photograph 84-424)

In the Proton area, E-715 set up in the PC beam line to measure $\Sigma^-\beta$ decay. Before their 1983-1984 run, there were only a handful of these rare decays in the world sample of data, and these events seemed to indicate that there was a problem with the Cabibbo theory. E-715 ran during the 400-GeV run, accumulating some 80,000 $\Sigma^-\beta$ decays. The Cabibbo theory survived; the question has been put to rest.

Two other experiments in the Proton area ran during the 400-GeV and 800-GeV accelerator cycles. Experiment 615 studied dimuon pairs at high Feynman X. The data is providing information on the QCD corrections to the Drell-Yan model and the higher twist effects. The experimenters are also looking for scaling violations. Experiment 615 took 700 and 850 hours of data respectively at 400 GeV and 800 GeV. They were the single largest user of proton intensity during the year. Most of their running was done with a negative pion beam, although some running was done with a positive beam.

Experiment 400, on the other hand, set out to study charm production by neutrons. They were able to accumulate data at a phenomenal rate thanks to a sophisticated trigger processor. They hope to have 1000 to 2000 charm events in their data sample.

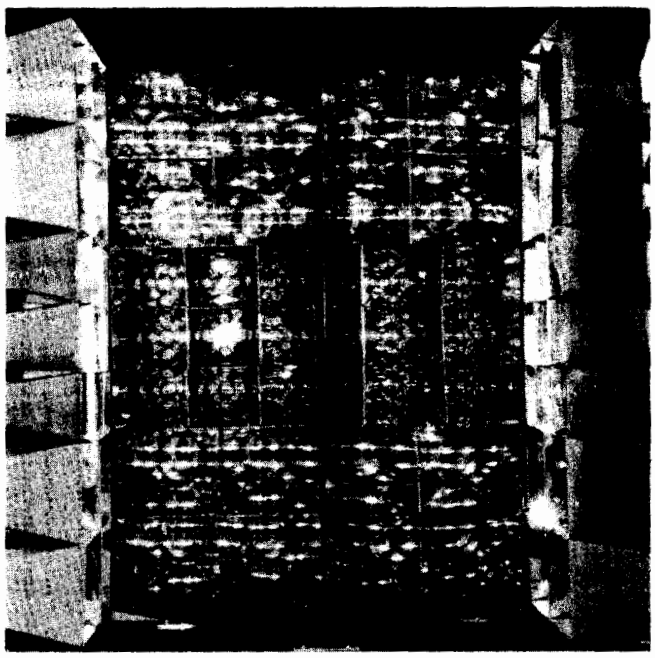


Located in the Proton Center Pit, the E-715 detector was used to accumulate some 80,000 rare $\Sigma^-\beta$ decays.
(Fermilab photograph 84-198-6)

Experiment 400 took data for approximately 600 hours at 400 GeV and another 600 hours at 800 GeV. Their 800-GeV run was terminated one month before the end of the run because of the Wide Band Beam construction schedule.

The final experiment to set up and run in the Proton area was E-621. This experiment replaced E-715 in the PC beam line. The objective was to measure the CP violating parameter η_{+-0} with high precision. The experiment managed to set up and begin debugging early enough to have actually achieved the data-taking mode. They are scheduled to come back during the next fixed-target running period.

It is evident that the Fermilab fixed-target physics program began picking up the tempo after a long lay-off for Saver installation and a slow start-up of the Saver and the new beam lines. Only a small number of experiments ran during the past year compared to the number that will run in the coming year, but the physics is already coming in. There is much promise for the future.



Looking down the barrel of one of the E-400 Cherenkov counters. Straight ahead are the mirrors which deflect the Cherenkov light into the photomultiplier cones at the left and right of the photo. (Fermilab photograph 83-1054-1)

Table I. Physics Summary

Exp.	Beam	Energy	Physics
E-400	Neutrals	400/800	Charm production by neutrons
E-605	Protons	" "	Dihadrons/leptons
E-615	Pions	" "	Dimuons
E-715	Protons	400	$\Sigma^-\beta$ decays
E-609	"	"	Jets
E-557	"	800	Jets w/muons
E-621	"	"	K decays

Table II. Operations Summary

Beam Line	Exp.	400 GeV	800 GeV
	Meson Area		
MT	E-609	X	-
MT	E-557	-	X
MB	T-741	X	X
MB	T-745	-	X
MB	E-660	X	X
MB	T-711	-	X
ME	E-605	X	X
	Neutrino Area		
NW	T-741	X	X
NW	T-665	X	X
NW	T-691	-	X
NW	T-740	-	X
	Proton Area		
PW	E-615	X	X
PC	E-715	X	-
PC	E-621	-	X
PE	E-400	X	X

BRIEF REPORT ON "THE SECOND WORKSHOP ON LASER ACCELERATION OF PARTICLES"

Lee C. Teng

Introduction

The Second Workshop on Laser Acceleration of Particles was held at the University of California-Los Angeles on January 7-17, 1985; the first one had been held almost three years ago at Los Alamos National Laboratory in February 1982. This workshop was attended by some 120 physicists and engineers experienced in particle-accelerator and laser technology, a 100% increase in participation over the first workshop. Between the two workshops we have seen tremendous progress in the field of laser acceleration methods. This progress is a direct result of the emphasis placed by research institutions and the strong support given by funding agencies on initiatives in this area which have made possible both theoretical and experimental efforts. Despite the title, the workshop broadened to include studies of all novel acceleration schemes, whether lasers are involved or not. To accomplish this and to cover all important work carried out since the first workshop we had to extend the duration of this workshop from the original 5 days to 9 days.

Progress on Various Acceleration Schemes

Substantial progress both theoretical and experimental has been made on all three basic types of laser accelerators: near field, far field, and plasma accelerators. Understandings gained from detailed studies of problems on laser excitation and propagation and on particle beam containment and stability have led to concentrations on those specific schemes which appear to be the most promising.

a. Near Field Accelerator - The possibility of forming miniature open linac structures with liquid metal microdroplets is under close scrutiny. The accelerating gradient in such structures is limited to ~1 GeV/m by droplets turning into plasma.

b. Far Field Accelerator - This is now considered to be simply the inverse free-electron-laser accelerator, the principle of which has already been demonstrated in several experiments. The maximum accelerating rate obtainable is ~0.2 GeV/m, and the top electron energy is limited to a few hundred GeV by synchrotron radiation loss from the electrons.

c. Plasma Accelerator - The most promising scheme at this time is the beat-wave accelerator. Excitation of plasma waves by the beat-wave of two lasers has now been demonstrated experimentally to be reproducible and in good agreement with computer simulation results. An accelerating field of

~1 GeV/m was measured in the experiment. Fields higher by an order of magnitude should be attainable.

For non-laser accelerators, the wakefield or two-beam acceleration schemes are the most promising and have received the most attention. In both schemes the electric field generated by a low energy, high current beam is used to accelerate a low current second beam to high energies. The two beams can be traveling in separate cavity structures, and the field is transmitted from one cavity to the other through couplers. Or, the two beams can be traveling in the same cavity. In either case, the ratio of the electric fields on the two beam trajectories must be very large. This is equivalent to having a large transformer ratio in a voltage step-up transformer. Experiments are being carried out at DESY (single cavity wakefield accelerator), and at LBL and LLNL (dual cavity two-beam accelerator). In addition, several other non-laser schemes were proposed and discussed at the workshop, but more careful and more extensive analyses are needed for these schemes.

Requirements for Colliding Beams Applications

At the first workshop the emphasis was almost exclusively on high accelerating fields and high energies. However, to gain full benefit from high energy colliding beams, i.e., to provide easily detectable rates for the occurrence of interesting events, one must also have sufficiently high luminosity, hence high beam intensity and low emittance. One set of parameters presented by Burton Richter (SLAC) in his opening talk for a 5 TeV on 5 TeV $e^{\pm}$ linear collider is the following:

Beam energy	5 TeV + 5 TeV
Luminosity desired	$10^{34}cm^{-2}sec^{-1}$
Normalized emittance	1.2×10^{-7} mrad
Beam radius at collision	1.0×10^{-2} μm
Bunch length at collision	0.3 mm
Number of particles per bunch	2.5×10^{9}
Bunch repetition rate	5000 Hz
Average power for two beams	20 MW

These numbers clearly illustrate the rather extreme magnitude of the demand. A sizeable effort on the part of one of the working groups at this workshop was devoted to examining means to fulfill these requirements on repetition rate, average beam power, and beam emittance.

The requisite high average beam power calls for high efficiencies both in the production of driver power, whether laser or microwave, and in the energy transfer from driver to particles. Although capable of extremely high peak, electric field lasers are, at present, not energy efficient; and their construction

cost per unit of average power is rather high. Energy efficiency considerations point to two directions:

a. Optimization of the driver-to-particle energy transfer efficiency tends to push toward lower peak accelerating field and longer accelerating structure. This also accentuates the need for staging the accelerating structure and the driver source.

b. Similar consideration also points to the use of millimeter and centimeter waves as driver instead of lasers. Compared to lasers the energy efficiency of microwave sources is much higher, the construction cost per unit of average power is much lower, although the peak field attainable is not as high. But in generating microwaves, lasers also find application. Microwaves can be induced in cavities by tightly bunched intense electron beams produced from photocathodes, irradiated by pulsed laser light.

Nevertheless, investigation on the possibilities of developing high efficiency, high repetition rate, short pulsed lasers should be pursued with vigor. Preliminary examinations carried out at the workshop give encouragement that these may indeed be realistic goals.

The desire for high luminosity also led to the need for very low beam emittance and very strong focusing lenses. To this end the possibility of using laser powered electric micro-quadrupoles to provide the required strong focusing was investigated. It appears possible to obtain a focal length of 5 m for a 50 GeV electron beam.

Working Group Activities

At this workshop the three identified schemes for laser acceleration of particles (the near field, the far field, and the plasma accelerators) were further studied in light of the new intensity requirement. To these three topics two others dealing with investigations of the necessary laser and accelerator technologies were added. In the following, we give short summaries of the activities and findings of each of these six working groups.

a. Near Field Accelerators

These are miniature open linac structures which support longitudinal accelerating field components (non-plane wave). Resonant structures such as arrays of liquid metal droplets ejected from micro-orifices (c.f. ink jets) were studied. Maximum accelerating fields with such structures without plasma production appear to be of the order of 1 GeV/m for 3 ps pulses and possibly 3 GeV/m at 300 fs. At higher gradients plasma production appears to rule out resonant structures. Non-resonant structures were also discussed and, in the droplet case, might provide very high gradients but probably with lower efficiency. Near field structures can

also generate super strong radio-frequency transverse quadrupole focusing which could be useful for focusing the beam at the colliding point.

A possible proof-of-principle experiment using the SLAC injector is planned. The setup could also be used for experiments on other types of accelerators such as inverse free electron laser, inverse Cherenkov, etc.

b. Far Field Accelerators

In this scheme the beam is wiggled laterally so that the particles are synchronously accelerated by the alternating transverse electric field of a plane laser wave. The principle scheme is the inverse free electron laser (IFEL) in which the electron beam is wiggled by a series of alternating static magnetic fields (undulator). Since the first workshop, free electron laser experiments have verified the theory, and the mechanism of IFEL has been observed. The acceleration rate for an IFEL accelerator is limited to less than a few hundred MeV/m, and the maximum energy is restricted by synchrotron radiation loss to less than a few hundred GeV. The necessary wiggle amplitude, hence the synchrotron radiation loss, can be reduced by modifying the resonance condition with the addition of a gaseous medium. Also, to form long sections of IFEL accelerator the laser beam must be kept focus~d in a wave-guide with dielectric walls. All these concepts look all right on paper, but should be confirmed experimentally.

The use of an IFEL to reduce the emittance of an electron beam was discussed. The damping effect is indeed present but rather weak. With presently available technology the damping length is too long to be useful. Further studies are required.

c. Plasma-Laser Accelerators

These concepts have been distilled down to a single scheme, the beat-wave plasma accelerator. In this scheme particles are accelerated by the very high electric field in a highly modulated high-density plasma wave which is, in turn, resonantly driven by the beat-wave of two laser beams. A great deal of analytical and numerical simulation work has been done since the first workshop.

On the experimental side, the UCLA experiment, using 10.6 μm and 9.6 μm CO_2 radiation, generated and detected the fast beat-wave reproducibly over a length of 1.5 mm (limited by the size of the plasma). The electron density modulation in the wave was measured to correspond to fields in the 300 MeV/m to 1 GeV/m range. A similar experiment is planned at the RAL using 1.06 μm and 1.05 μm radiations from glass lasers. An unsuccessful experiment at LANL using a single frequency and a long pulse from the HELOIS laser was

analyzed by two-dimensional computer simulation, and the outcome of the experiment was found to be predictable.

The transverse focusing of the particles by the plasma tends to be excessively strong, making matching between stages rather difficult. This prompted people to look into very long self-focused laser channels. Such channels appear to be feasible.

The near term goals for experiments were discussed and should consist of:

1. Demonstrate significant acceleration of electrons, say, from 10 to 100 MeV.
2. Study relativistic self-focusing of the laser beam and its propagation over long distances, say, up to 100 m.
3. Investigate whether there is much emittance blow-up during acceleration.
4. Determine the efficiencies of energy transfer from laser to plasma wave and from plasma wave to particle beam.

d. Accelerator Technology

A central problem is the derivation and retention of a small electron beam emittance. Several alternative methods were investigated. Damping the emittance in a damping ring looks most favorable. Single-pass damping by the use of a wiggler requires excessive length. Beam collimation by scraping is effective but will greatly reduce the beam intensity. Some emittance blow-up during acceleration is unavoidable due to misalignments and non-linear fields. The different acceleration schemes were studied and compared in this regard.

Phase space matching between acceleration stages was also studied in some detail. Longitudinally, phase locking between stages is principally a problem in laser technology and appears to be solvable. Transverse phase space matching between stages of the very strong focusing beat-wave plasma accelerator may require the use of the very strong "laser lens."

The basic scaling laws for high-energy colliding-beam parameters such as energy, luminosity, disruption parameter, beamstrahlung, etc., were reviewed. It was concluded that the sets of equations used by different investigators are consistent and appropriate, and can be used with confidence to consider trade-offs.

The acceleration schemes were studied also in regard to energy efficiency and cost. The overall wall-plug to beam power efficiency for all the laser schemes is, at present, one to two orders of magnitude lower than the > 10% achievable with conventional radiofrequency technology. The same

is true for cost per unit of average power. Thus the challenge to laser technology has been clearly formulated.

e. Laser Technology

The newly introduced requirements on the laser systems are the need for a large number of precision phase-locked stages, and the desire for high average power (high repetition rate) and high energy conversion efficiency. Studies made during the workshop resulted in the conclusion that:

1. Phasing between multiple stages presents no major problem, and synchronization between electron and laser beams is obtainable at repetition rates < 15 Hz.
2. Wall-plug to laser energy conversion efficiency higher than 10% would be difficult. Multiple use of the gain medium is necessary to approach even this value. To obtain high efficiency for FEL's, fast switching methods are needed.
3. Repetition rates up to 100 Hz are possible for glass lasers with thin panes of glass, and up to 1000 Hz are possible for gas lasers. To this extent, high average power is obtainable; however, it will be very costly.
4. Ultra-short, high-peak power lasers with pulse length down to 1 ps are possible.
5. Side coupling, such as to an open linac structure, is easy. End coupling, such as to a beat-wave self-focused channel, is more difficult.
6. For the plasma beat-wave accelerator, detailed examinations led to the conclusions that short wavelengths (< 1 μm) are best, and plasma wavelengths of 10-100 μm seem to give the best options for laser pulse length and energy. Propagation of the laser in the dispersive plasma is a concern, as is the use of long self-focused laser beam channels.

f. Other Schemes

The major effort was spent on the wakefield or two-beam acceleration scheme in which the field produced by a low-energy, high-intensity beam is used to accelerate a second low-intensity beam to a high energy. The two beams could travel in separate cavity structures with the fields transmitted from the generator structure to the driver structure through couplers. This is equivalent in principle to powering a linac structure by a klystron. In the experiment being conducted by LBL and LLNL 1-cm waves are produced by a wiggling low-energy beam in a long generator structure through the FEL action. The energy of the beam is replenished in regular intervals by induction cores. The two beams could also be in the same cavity. In this case, one can prove a theorem which states that the transformer ratio (energy of beam 2 particle to that of beam 1 particle) can at most be 2 if the two beam bunches are colinear and have zero length (δ-functions). To obtain a useful transformer ratio one must, therefore, use long beam bunches or non-colinear geometries. A simple and effective arrangement

due to Voss and Weiland is one for which the generating beam is in the shape of a series of rings and travels inside a tight-fitting cylindrical cavity. The wake field propagates radially inward and superimposes constructively to produce a very high longitudinal accelerating field on the axis. The axial field can be further enhanced by using irises in the wave guide to channel the propagation of field toward the axis. Several other geometries were proposed and studied. The wakefield acceleration principle can also be applied to beams traveling in a plasma.

Other schemes considered are:

1. The *inverse Cherenkov* accelerator, proposed a long time ago and for which a great deal of theoretical design work has been done, was tested in a proof-of-principle experiment. The main concern for this scheme is the emittance growth due to multiple scattering in the gas medium.
2. The *laser-focus* accelerator, which was also described at the first workshop, has been tested experimentally. Ion energies greater than 100 MeV have been observed.
3. The *radial implosion* accelerator, in which radially inward electron beams are used to "squeeze" an axial magnetic field and, hence, produce a high electric field (up to 3 GeV/m) on the axis.
4. The use of a laser to focus, not to accelerate, an electron beam was investigated. It appears possible to develop rather strong lenses (3 m focal length for 50 GeV electrons).

Experiments are starting again at DESY on the ring-beam wakefield accelerator and are in progress at LBL on the two-beam accelerator. The latter may yield, as a first step, a high intensity 1 cm microwave source. The inverse Cherenkov accelerator, the laser-focus accelerator, and the laser lens are ready for further experimental studies. Theoretical and numerical work should be pursued on all other schemes.

Conclusions

This second workshop confirmed the promise and likely payoff of a variety of schemes. Gauged from the very large proportions of the Superconducting Super Collider (SSC), it is clear that the efforts on research and development into new methods of acceleration are the only hope for further advances in high-energy accelerators and particle physics beyond the SSC. Thus, not only do we see needs for continued support of the on-going efforts, but we also visualize the exigency for additional and intensified new activities to ensure continued strong growth in this field.

REVIEW MEETING SCHEDULE

The workshop described in the preceding article by Lee Teng was followed up by a review meeting at Fermilab as listed below:

MINI-SYMPOSIUM ON ADVANCED CONCEPTS FOR ACCELERATION
OF PARTICLES TO HIGH ENERGIES
MARCH 5, 1985
FERMILAB
WILSON HALL - CURIA II (2 SOUTHWEST)

MORNING SESSION

Welcome	L. Lederman
Introduction	L. Teng
Direct Laser Accelerators	R. Palmer (BNL/SLAC)
Plasma Beat-Wave Accelerator	C. Joshi (UCLA)

AFTERNOON SESSION

Other Schemes	A. Sessler (LBL)
Laser Technology	S. Singer (LANL)

A view along the Muon Beam Line showing the two superconducting analysis magnets for E-665. The foreground magnet was borrowed from CERN for this use. (Fermilab photograph 85-155-7)

MANUSCRIPTS, NOTES, LECTURES, AND COLLOQUIA PREPARED OR PRESENTED FROM FEBRUARY 18, 1985 TO MARCH 17, 1985

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

E. Anassontzis et al. Experiment #537	Continuum Dimuon Production in $\bar{p}$-W Collisions at 125 GeV/c (FERMILAB-Pub-85/34-E; submitted to Phys. Rev. Lett.)
E. Anassontzis et al. Experiment #537	A Large Aperture Spectrometer at Fermilab to Study High Mass Dimuons (FERMILAB-Pub-85/35-E; submitted to Nucl. Instrum. Methods)

Astrophysics

J. Audouze et al.	Big Bang Photosynthesis and Pregalactic Nucleosynthesis of Light Elements (FERMILAB-Pub-84/121-A; submitted to Astrophysical Journal)
K. A. Olive	Primordial Inflation and Supergravity (FERMILAB-Pub-84/131-A; submitted to Astrophysical Journal)
M. S. Turner	Quantitative Analysis of the Thermal Damping of Coherent Axion Oscillations (FERMILAB-Pub-84/132-A; submitted to Phys. Rev. D)
E. W. Kolb et al.	The Shadow World (FERMILAB-Pub-85/16-A; submitted to Nature)
E. W. Kolb	Cosmology in Theories with Extra Dimensions (FERMILAB-Conf-85/17-A; submitted to the Proceedings of the Annual Meeting of the Division of Particles and Fields of the American Physical Society, Santa Fe, New Mexico, October 31-November 3, 1984)
F. S. Accetta et al.	Induced Gravity Inflation (FERMILAB-Pub-85/22-A; submitted to Phys. Rev. D)

J. A. Frieman et al.	Superheavy Magnetic Monopoles and Main Sequence Stars (FERMILAB-Pub-85/25-A; submitted to Astrophysical Journal)

General

B. Cox and F. J. Gilman	Standard Electroweak Interactions and Higgs Bosons (FERMILAB-Conf-85/33; submitted to the 1984 Summer Study on the Design and Utilization of the Superconducting Super Collider, Snowmass, Colorado, June 23-July 13, 1984)
J. D. Bjorken	Fixed-Target Physics at Fermilab (FERMILAB-Conf-85/36; presented at the Annual Meeting of the Division of Particles and Fields of the American Physical Society, Santa Fe, New Mexico, October 31-November 3, 1984)
G. Chartrand	Interfacing to VAX/VMS Systems (Presented at the Micom Users Group Conference, Oak Brook, Illinois, January 29, 1985)
G. Chartrand	Matrix Gateway for Multiple Port Selectors (Presented at the Micom Users Group Conference, Oak Brook, Illinois, January 29, 1985)
G. Chartrand	Parity Conversion Using a Buffer Box (Presented at the Micom Users Group Conference, Oak Brook, Illinois, January 29, 1985)
L. Lederman	Physics at the Tevatron (Presented at the Annual Meeting of the Division of Particles and Fields of the American Physical Society, Santa Fe, New Mexico, October 31-November 3, 1984)
L. Teng	Brief Report on "The Second Workshop on Laser Acceleration of Particles" (Contributed to the Second Workshop on Laser Acceleration of Particles, UCLA, January, 7-17, 1985)
A. V. Tollestrup and the CDF Collaboration	CDF at Fermilab: A Progress Report (Submitted to the Proceedings of the First Aspen Winter Physics Conference, Aspen, Colorado, January 6-12, 1985)

A. Van Ginneken	Rapid Generation of Electromagnetic Showers in Hadronic Cascades (Presented at the "LEP Detector Simulation Workshop," CERN, Geneva, January 20-25, 1985)

Colloquia, Lectures, and Seminars

L. Lederman	"Outstanding Engineering Achievement Award" (Fermilab, February 18, 1985)
R. Orr	"Accelerator Division Information Meeting" (Fermilab, February 19, 1985)
C. Hill	"Applications of a Covariant Functional Schroedinger Formalism" (Fermilab, February 25, 1985)
J. Hangst, J. Krider, and J. Peoples	"Status of the Antiproton Source" (Fermilab, February 26, 1985)
A. Lennox and L. Ketcham	"Alignment of the Beam Lines and the Debuncher" (Fermilab, February 28, 1985)
P. Rapidis	"Status of Instrumentation for the $\bar{p}$ Yield Measurement" (Fermilab, February 28, 1985)
S. Mtingwa	"Status of the Installation of the Pickup and Kicker Tanks" (Fermilab, February 28, 1985)
J. Krider	"Secondary Emission Multiwire Chamber for $\bar{p}$ Source at Fermilab (Fermilab, February 28, 1985)
J. Yoh	"Physics at CDF" (Fermilab, March 4 and 6, 1985)
J. Marriner	"The Installation Schedule for the Accumulator" (Fermilab, March 7, 1985)
G. Biallas	"Handling of Target System Components in the Event of Component Failure" (Fermilab, March 7, 1985)
J. McCarthy	"The Final Configuration of the Antiproton Source Power Supply" (Fermilab, March 7, 1985)

H. Thacker	"Lorentz Invariance on a Lattice" (Fermilab, March 12, 1985)
J. Petter	"Diagnostics and Current Monitors" (Fermilab, March 14, 1985)
A. Moretti	"Status of Debuncher rf System Installation and Testing" (Fermilab, March 14, 1985)

A view of the new Wide Band Experimental Hall, future home of E-687 and E-683. (Fermilab photograph 85-156-8)

Accumulator injection kicker covered with ceramic wool insulation in preparation for baking at 300° C.
(Fermilab photograph 85-173-22A)

A clamshell crane from the Illinois Hydraulic Company excavates earth from the argon dewar pit at the site of the future M West Experimental Hall. (Fermilab photograph 85-154-8)

DATES TO REMEMBER

March 28-30, 1985	Symposium on Anomalies, Geometry and Topology, Argonne National Laboratory and the University of Chicago. For further information contact Alan White, HEP 362, Argonne National Laboratory, Argonne, Illinois 60439; (312) 972-7381.
April 19-20, 1985	PAC Proposal Presentation Meeting
May 1-4, 1985	International Symposium on Particle Physics in the 1950s: Pions to Quarks, Fermi National Accelerator Laboratory. For more information, write L. Hoddeson, Fermilab, P. O. Box 500, Batavia, Illinois 60510
May 6-7, 1985	Heavy Quark Workshop. For information, contact Phyllis Hale, Users Office, MS #103, Fermilab, P. O. Box 500, Batavia, Illinois 60510; (312) 840-3111
May 10-11, 1985	Annual Users Meeting
May 21-22, 1985	Fifth Annual Industrial Affiliates Meeting
June 15-21, 1985	Extended Summer Meeting of the Physics Advisory Committee
July 15-26, 1985	1985 U.S. Summer School on High Energy Particle Accelerators at SLAC