

HEPAP Meeting

High Energy Physics Program
Argonne National Laboratory

November 7, 2002

Lawrence E. Price, Division Director



Scientific Research Projects

HEP at ANL

Accelerator Physics

- **Development and use of Argonne Wakefield Accelerator (AWA) testbed to demonstrate wakefield acceleration in dielectrics and plasmas**
 - ◆ *record-setting electron gun, driving linac testbed to generate wakefields*
- **Muon Collider and other Accelerator Physics topics**

Theoretical Physics

- **Phenomenological, formal, and computational theory with some concentration on collider physics**

Experimental Physics

- **Multi-year experiments and programs of systematic measurements using detector systems built in collaboration with university and laboratory groups in the US and abroad.**



Experimental Projects

HEP at ANL

CDF

- Long-term flagship detector at Tevatron collider
 - ♦ *Important opportunities for discovery in next several years*

ZEUS

- ep collisions at DESY/HERA
 - ♦ *proton and photon structure; QCD tests; searches for non-standard phenomena*

Soudan 2

- Deep mine calorimeter experiment in Minnesota
 - ♦ *Search for nucleon decay and n - \bar{n} oscillation; Atmospheric neutrino flavor ratio; Other cosmic ray topics*

MINOS

- Neutrino oscillations from FNAL Main Injector ν beam
 - ♦ *Detector in new cavern in Soudan mine*

ATLAS

- Higgs or other EW symmetry breaking at LHC
 - ♦ *Argonne tasks: Barrel hadronic calorimeter, Level 2 trigger, Computing system*

Polarized and Medium Energy Physics



Argonne plays key roles in the US HEP program

HEP at ANL

Building detectors

Inventing and developing technology for HEP

Making facilities work for physics

**Data analysis and physics results (expt and
theory)**

Collaboration with universities

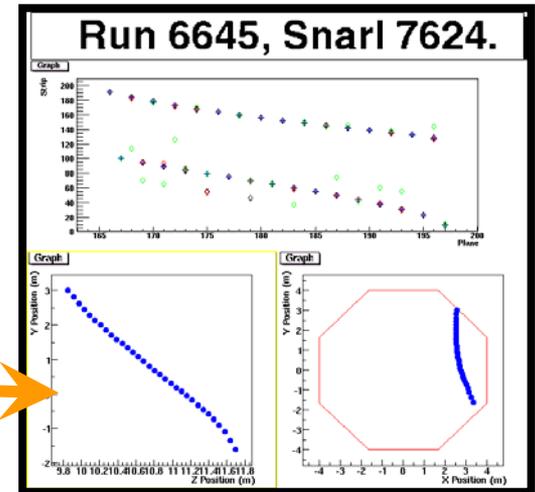
Leadership



Building detectors

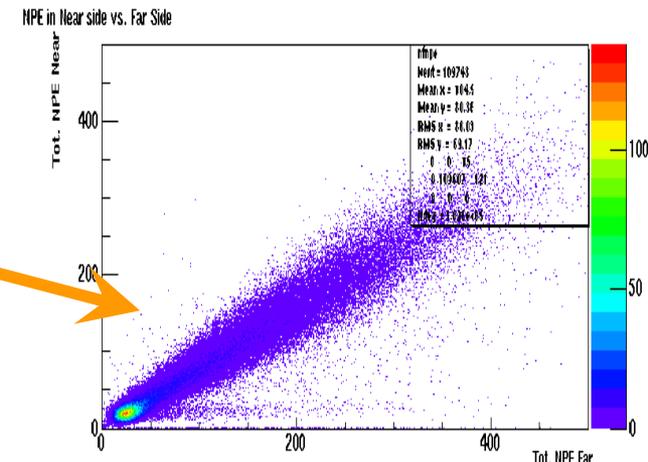
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MINOS scintillator module fabrication is over 90% completed at ANL, Caltech, and U. Minn. 1st supermodule completed in mine. Routinely recording atmospheric neutrino and muon events



ANL design/prototyping of MINOS near-detector front-end electronics.

- ANL led the successful beam test and calibration of prototype quantities of near detector electronics at CERN, in close collaboration with Fermilab, Rutherford, IIT, Oxford and UC London

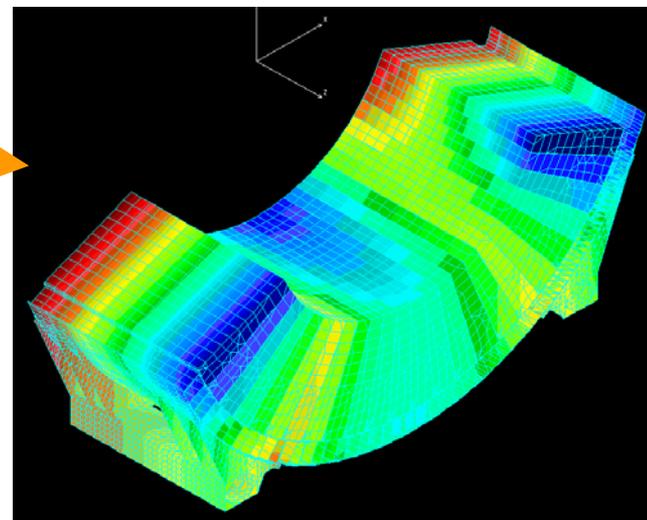
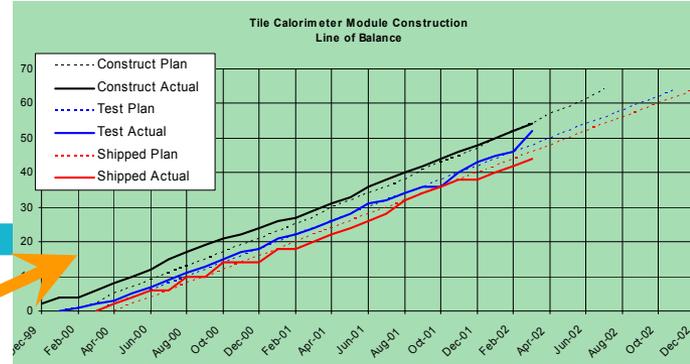


Building detectors

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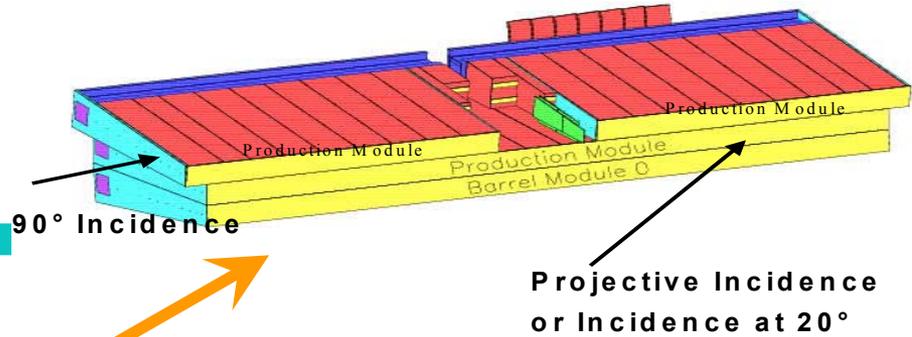
ATLAS Tile Calorimeter is finishing fabrication on schedule and preparing for pre-operations and installation

Gigabit Ethernet “Link Source Card” developed to permit additional use of commodity hardware with ROI Builder and the rest of the ATLAS HLT (LHCB also interested)



Building detectors

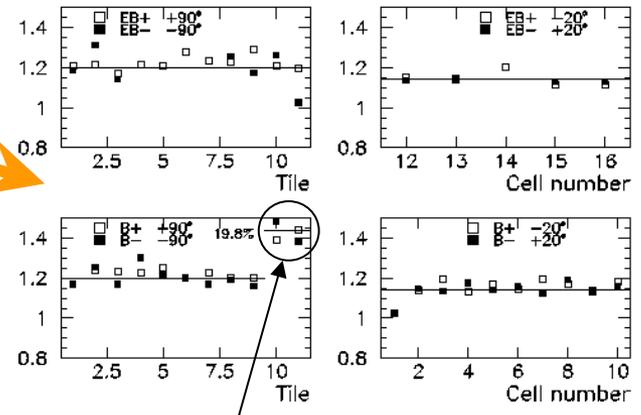
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Last week's results

5K events/data point

20 GeV electrons



Leadership of Tile Calorimeter Beam Test

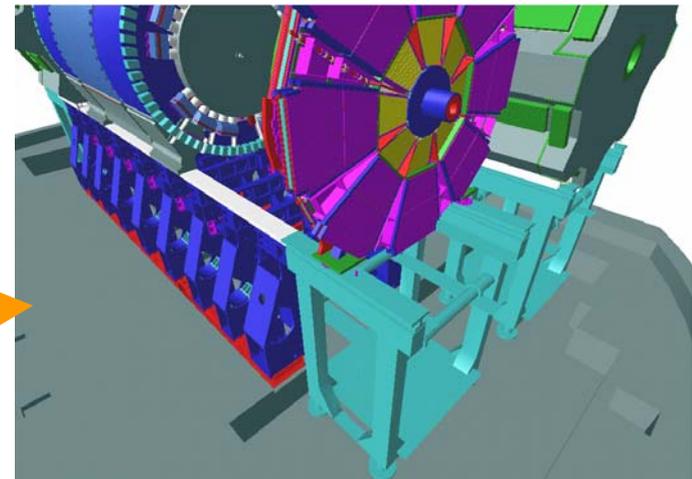
- 1/8 of modules get detailed beam calibration

ATLAS Computing

- Provided persistence service for Pythia, Isajet, Herwig, ATLFast
- Provided grid data access from ATLAS Athena framework
- Provided virtual data machinery for DC1 Phase 1
- Led first LHC RTAG that defined a persistency common project

ATLAS Technical Coordination

- New effort focused on moving of massive endcap components for detector access



Inventing & developing technology

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The new AWA gun is commissioned

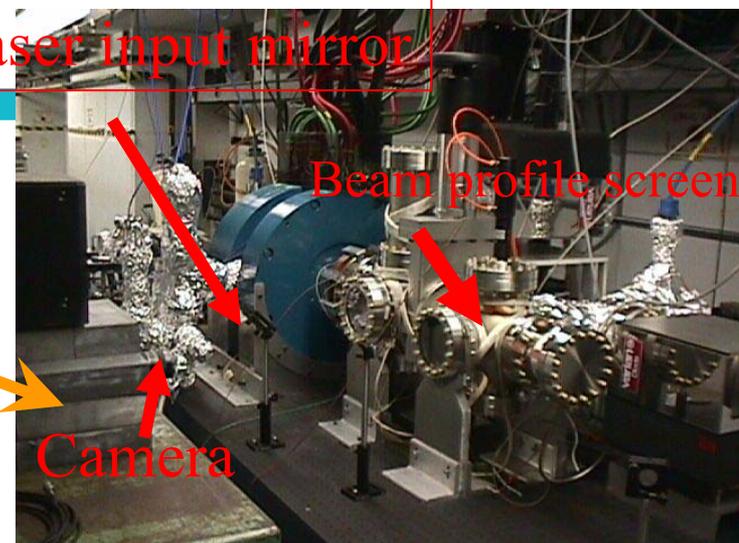
- high charge, high energy (> 8 MeV), high brightness (< 2 mm-mrad/nC) operation. Pulse train mode with > 40 nC/pulse, > 60 pulses/sec
- 20 nC pulses with Cu cathode; expect > 100 nC with Mg cathode
- Ultra stable, all solid state Ti:Sapphire laser being installed (> 2 mJ UV pp)

High Power test of dielectric loaded accelerating structure at NRL

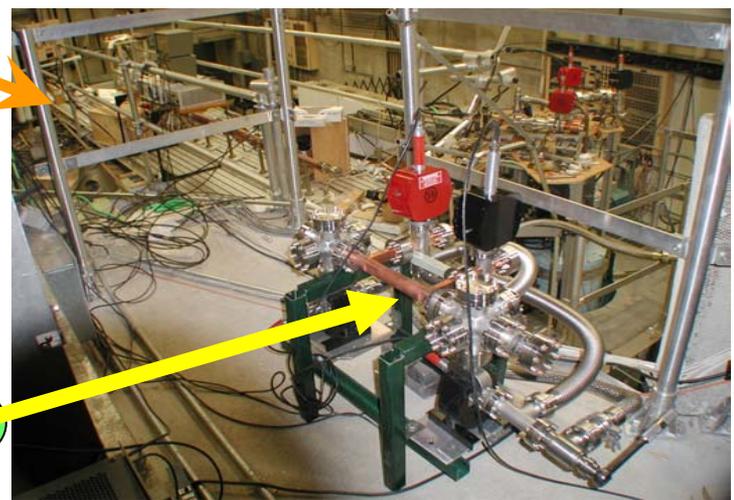
Next generation neutrino detectors

- NuMI off axis detector (ANL contributions to LOI and detector R&D report), UNO,...

Laser input mirror



DLA

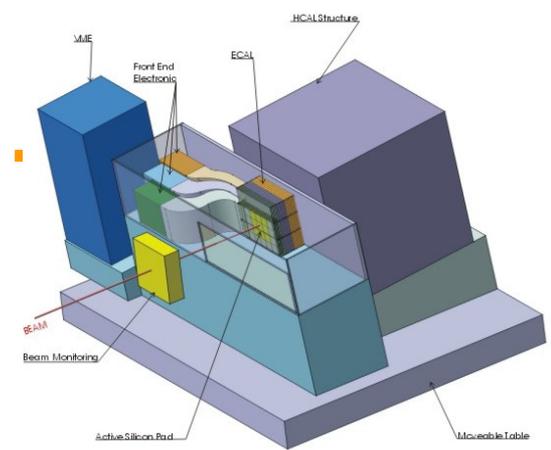
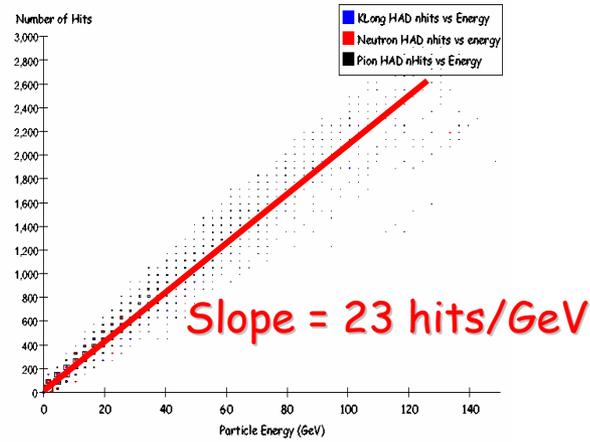
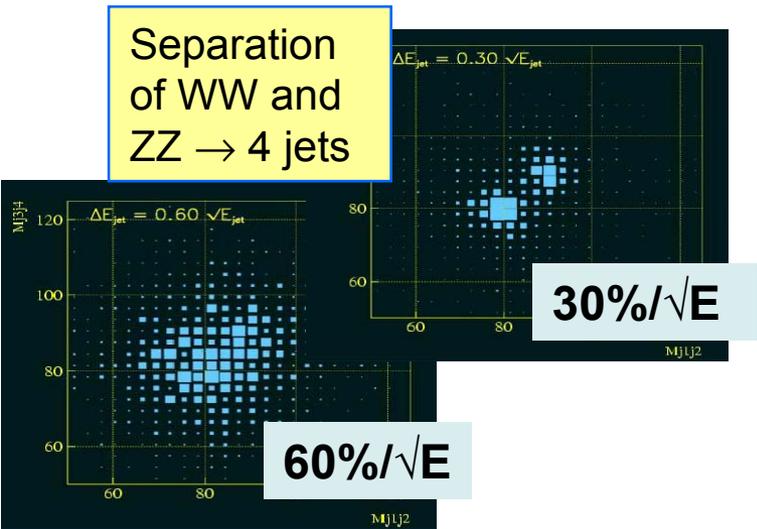


Inventing & developing technology

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Calorimetry for the Linear Collider

- Focus on jet resolution
 - ◆ Many important final states have 2-10 jets
 - ◆ Explore digital Hcal for use with energy flow algorithms
- Development of RPCs as candidate technology for affordable digital readout (collaboration with NUMI off-axis detector)
 - ◆ Including readout system optimized for >50M pads
- Working toward 1m³ calorimeter for beam test in 2004

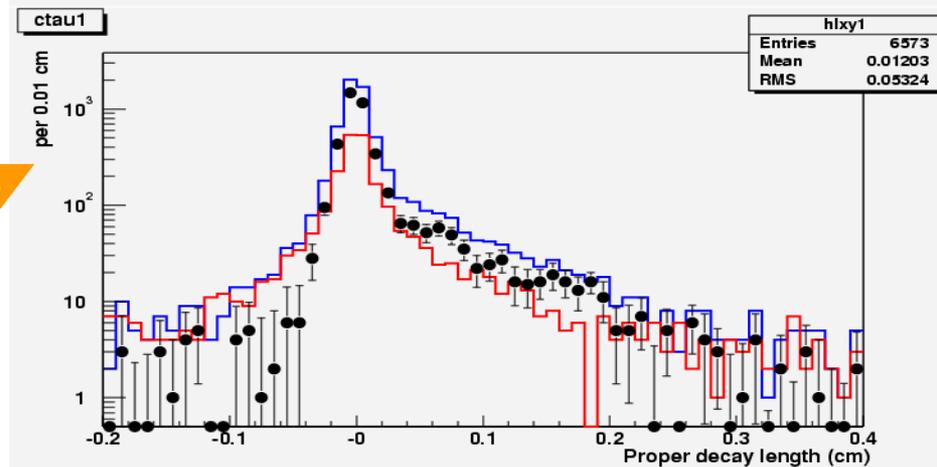
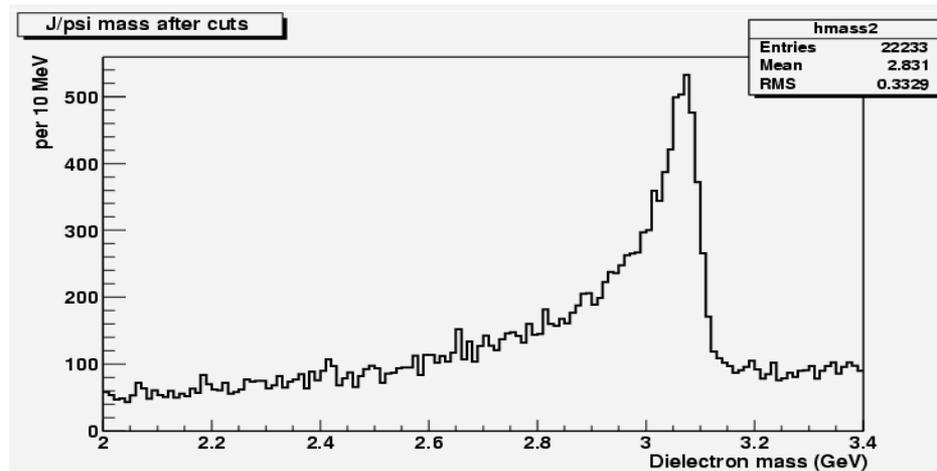


Making detectors work for physics

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CDF

- Specific Run II responsibility for shower max and preshower detectors, including front-end electronics
- Continuing responsibility for central EM cal, including overall calibration procedures
- As a result, ANL has generally taken major responsibility for overall electron calibration and identification
 - ◆ *Crucial for high E_T e id for W, Z, top, and many b-physics signatures, including flavor-tagging*
 - ◆ *Lead role in L2 e and γ trigger implementation*



Making facilities work for physics

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ZEUS Operating Responsibilities

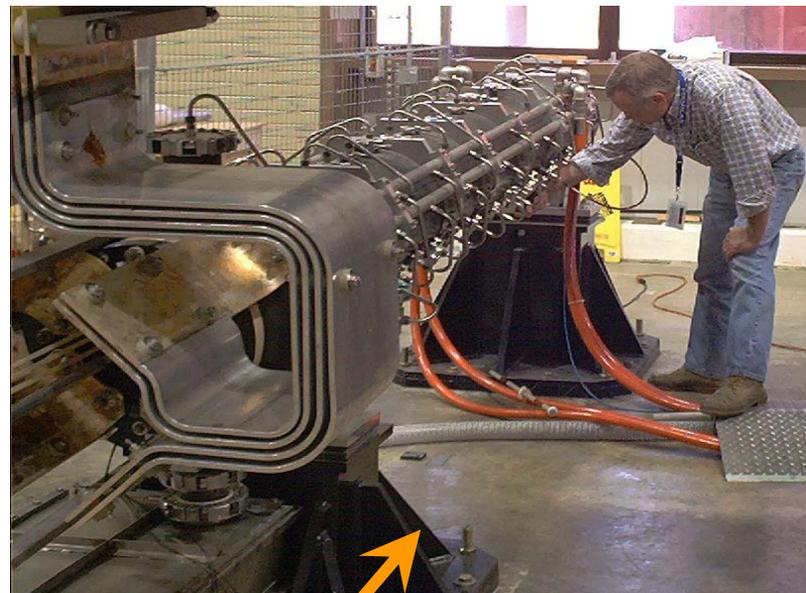
- Calorimeter
- Calorimeter First Level Trigger Processor
- SRTD First Level Trigger
- Barrel Presampler
- Straw Tube Tracker Electronics

ATLAS Preops (start now)

- Calorimeter preassembly
- Test beam module calibration

NuMI/MINOS Beam Line

- NuMI neutrino beam devices in critical areas of construction, integration, installation.
 - ◆ *Hot handling facility construction*
 - ◆ *horn alignment and B-field mapping systems,*
 - ◆ *neutrino beam diagnostic device implementation*



Physics results

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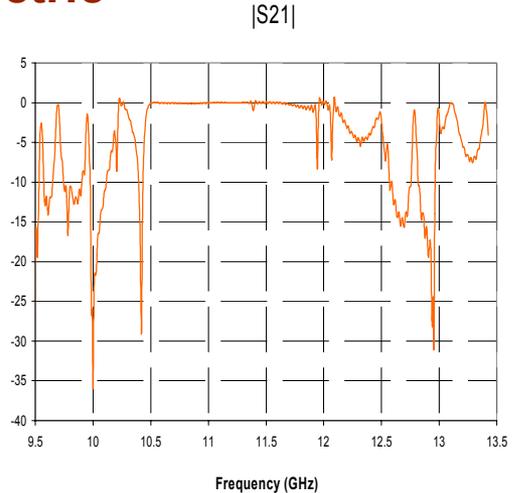
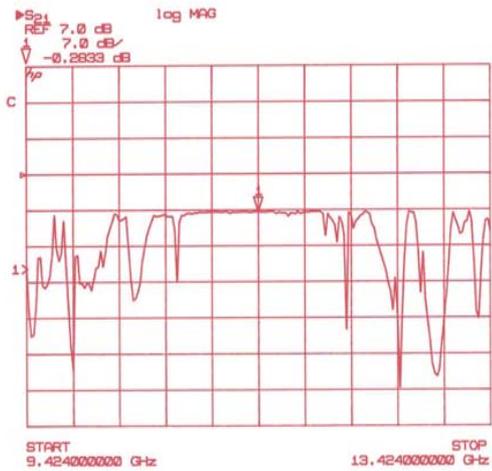
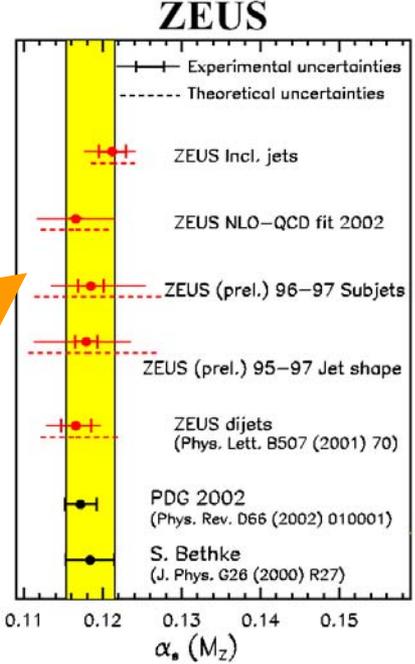


ZEUS continues to be very productive, with focus on structure functions, QCD, and diffraction

- *E.g.*, new precision measurement of α_s , comparable in precision to LEP

Wakefield accelerator rf structure and waveguide coupling studies

- *E.g.*, simulation and bench tests of new design for X-band Dielectric Loaded Accelerator

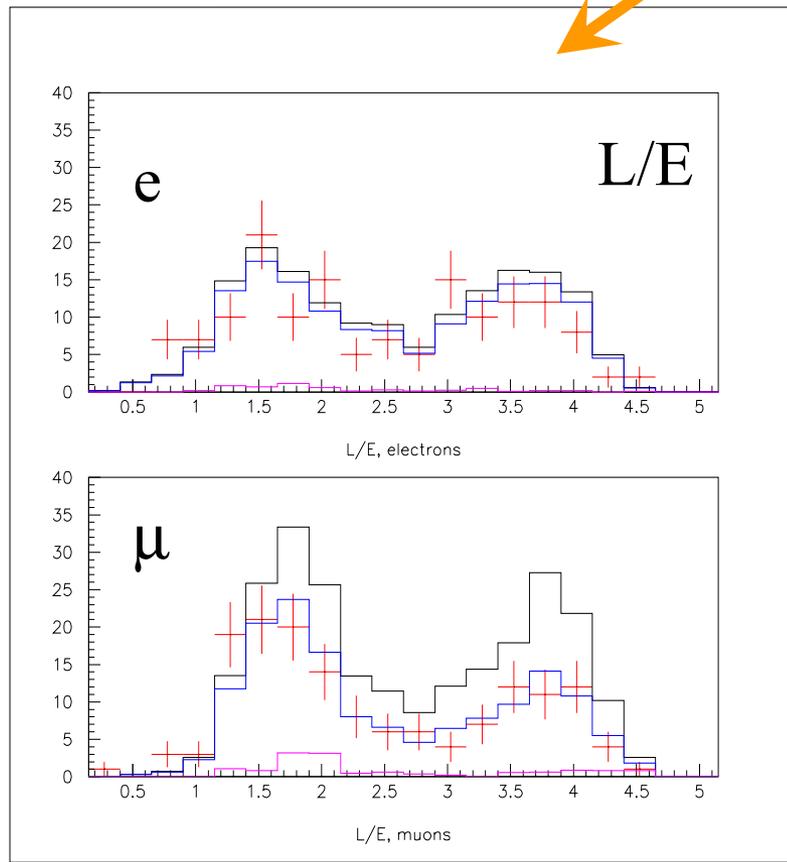


Physics results

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Soudan 2

- indep. measurement of neutrino oscillation parameters

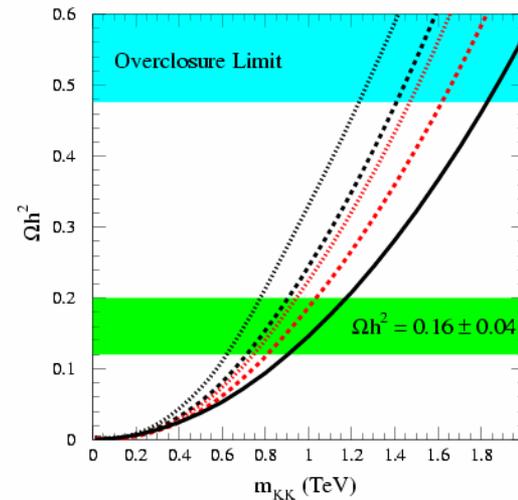


Theory—many results

– *E.g.*,

Geraldine Servant, T. Tait, hep-ph/0206071:

- Analyzed the properties of lightest Kaluza Klein particle, as a dark matter candidate.



- Mass has to lie in a narrow range around 1 TeV.
- Typical Weakly Interacting Massive Particle and has the new property that it is a gauge boson.

Principal U.S. University Collaborators

HEP at ANL

Univ. Wisconsin
Penn State Univ.
Michigan State Univ.
Univ. Chicago
Alabama
Univ. Illinois
Univ. Texas at Arlington
Indiana Univ.
Illinois Institute of Technology
Boston Univ.
Columbia
Harvard
Western Washington U.
Iowa State U.

UCLA
Michigan
Yale
Berkeley
Miami
Rochester
Brandeis
Rockefeller
Texas Tech
Tufts Univ.
Univ. Minnesota
Caltech
Univ. Texas at Austin



Project Leadership

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Rik Yoshida is the chairman of the US ZEUS collaboration

- Incoming ZEUS Spokesman

Dave Ayres is Deputy Spokesman of MINOS

Dave Ayres is Deputy MINOS Manager

Malcolm Derrick (ret) is ZEUS Physics Chairman

Jim Proudfoot is Associate Head of CDF Operations

Physics Analysis Coordinators

- ZEUS QCD (Sergei Chekanov)
- ZEUS Structure Functions (Rik Yoshida)
- CDF QCD (Bob Blair, recently completed term)

Shift Leaders: Zeus, CDF, MINOS



Project Leadership

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Detector system Coordinators

- ZEUS Presampler (Steve Magill)
- US ATLAS Tile Calorimeter (Larry Price)
 - ♦ *Mechanical components (Jim Proudfoot)*
- US ATLAS Trigger/DAQ (Bob Blair)
- ATLAS Tile Test Beam Coordinator (Bob Stanek)
- ATLAS Database Coordinator (David Malon)
- CDF Calorimeter Coordinator (Karen Byrum, Larry Nodulman)
- CDF Run IIb Calorimeter (Steve Kuhlmann)
- MINOS Electronics (Jonathan Thron)
 - ♦ *Near Detector front ends (Gary Drake)*
- MINOS Scintillator Factories (Jim Grudzinski)
- NuMI Neutrino Beam Devices (Dave Ayres)

ZEUS Editorial Panel (Jose Repond)



Summary of ANL Divisions

(HEP has substantive interactions with those in bold)

HEP at ANL

Advanced Photon Source

Biosciences

Chemical Technology

Chemistry

Decision and Information Sciences

Division of Educational Programs

**Electronics and Computing
Technologies**

Energy Systems

Energy Technology

Environmental Assessment

Environmental Research

High Energy Physics

Industrial Technology Development
Center

Intense Pulsed Neutron Source

Mathematics and Computer Science

Materials Science

Physics

Reactor Analysis

Reactor Engineering

Structural Biology Center

Technology Development

Chief Financial Officer

Central Shops

Environment, Safety, and Health

Human Resources

Information and Publ. Div.

Medical Department

Plant Facilities and Services

Office of Safeguards and Security



HEP Community Service Highlights

HEP at ANL

CTEQ Spokesman
Journal Editor
Member, PDG
Adjunct Professor
Conf. Org/Adv Committees
Review Committees

ANL Labwide committees

Conference Conveners

Journal Referees

Kuhlmann
Derrick, Malon
Goodman
Berger
Many!
Berger, LeCompte
Proudfoot
Ayres, Berger, Byrum,
Gai, Nodulman, Price
Berger, Bodwin,
Conde, Repond,
Wagner
Many!



Argonne Summary

HEP at ANL

Strong multifaceted program

Central roles in high priority projects

- **Accelerator R&D, Theory, Experiment**
- **Linear Collider R&D**

Multipurpose national laboratory resources are leveraged for HEP

Budget constraints are cutting into vital capabilities

