University of Chicago Review

High Energy Physics Division
Argonne National Laboratory

August 31, 2004

Overview

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.**
- **Current projects: CDF, ZEUS, MINOS, ATLAS, STAR**

Some Foci of the Past Year

New Experimental Projects

- Linear Collider R&D
- Neutrino oscillations and properties
  - *Work on Soudan 2 and MINOS has led to new questions about neutrinos and many ideas for answering them*
  - *A NuMI "off-axis" experiment NOvA and an experiment using reactor neutrinos are both in active planning stages, though the time scales are presumably different*
  - *ANL is actively involved both as neutrino experts and for detector engineering*
- Astroparticle Physics
  - *Interest in the Pierre Auger Observatory when it was starting up several years ago, but other commitments led us to withdraw then.*
  - *Now Auger is beginning to think about a second site and about improvements and additions to their technology.*
  - *And colleagues at the University of Chicago are thinking about a second phase for the VERITAS air Cerenkov detector*
  - *We would bring both physics knowledge and technical expertise to either of these experiments.*

Some Foci of the Past Year

HEP at ANL

Long Range Planning

- **Detailed plan for next 5 years**
- **6 month study led by Division Planning Group**
- **Copies of report provided to reviewers**
- **Part of thinking about new projects, in the context of the evolution of existing projects**

Theory Group

- **Attention to issues raised by DOE and other reviews**
  - ***Success in hiring top-flight junior staff theorist after two years of work***
    - Tim Tait will join the HEP Division in October
  - ***More work on applications and mainstream HEP by the most formal member of the group***
  - ***Additional engagement in the community through organization of workshops and conferences, talks, etc.***
- **Labwide Theory Initiative**

Advanced Accelerator R&D

- **Labwide Accelerator Initiative**

Balance of Physics and Technical Resources

HEP at ANL

2 major "support" groups provide technical innovation, engineering, and experienced technicians, drawn on by all projects

- **Electronics**
- **Mechanical**

The work of these groups evolves with time

- **ATLAS and MINOS design, prototypes, and then production have been the major focus in recent years**
- **As production comes to an end (already for mechanical work, after another year for electronic), new priorities take over**
  - ***ATLAS Installation at CERN***
  - ***MINOS installation at FNAL***
  - ***R&D for new and exploratory projects***

Computer support group operates and configures Division computing, but is not the primary locus of expertise for designing and building software for physics projects

- **A dedicated group has been built for ATLAS CORE, Reconstruction, and Grid software**

Balance of Physics and Technical Resources

HEP at ANL

Leveraging resources of multi-program national laboratory (and University contractor)

- **Accelerator R&D collaborations with Advanced Photon Source**
- **Computer Scientists for ATLAS Software from Decision and Information Sciences Division**
- **Radiation tests of electronics at Intense Pulsed Neutron Source**
- **Grid Computing for ATLAS with Math and Computer Science Division**
- **Simulation of targets in intense proton beams from Reactor Engineering and Analysis**
- **MINOS materials background measurement from Chemical Technology Division**
- **Labwide accelerator coordination group includes APS, Chemistry, Physics, IPNS**
- **Physics of reactors for neutrino experiments, Reactor Engineering**
- **Collaborations with University of Chicago**
  - ***ATLAS, CDF, Linear Collider, Veritas, Off Axis Nu, Reactor Nu***

Leveraging resources of multi-program national laboratory

Support for new and special projects from Laboratory funds

- **Laboratory Directed R&D (LDRD) funds**
  - ***Linear Collider project on digital hadronic calorimetry***
  - ***Linear Collider project on high brightness electron guns***
  - ***Accelerator project on fundamental understanding of rf cavity breakdown mechanisms and strategies for conditioning***
  - ***Collaboration with FNAL on Run II accelerator topics***
- **ALD Reserve Funds**
  - ***Assistance with junior theory hire***
- **New ANL Named Fellowship Program**
  - ***Super postdoc***
  - ***HEP got one of five awarded across the Laboratory last year***
    - Bill Ashmanskas, working on CDF and accelerator physics
      - **Since moved to tenure track position at Cornell**

Principal U.S. University Collaborators

HEP at ANL

Univ. Alabama
Univ. Calif. Berkeley
Boston University
Brandeis Univ.
Caltech
Univ. Chicago
Columbia Univ.
Univ. Illinois
Harvard Univ.
Illinois Institute of Technology
Indiana Univ.
Iowa State U.
Michigan State Univ.
Univ. Miami
Univ. Michigan
Univ. Minnesota
Penn State Univ.
Univ. Rochester
Rockefeller Univ.
Univ. Texas at Arlington
Univ. Texas at Austin
Texas Tech
Tufts Univ.
Univ. Wisconsin UCLA
Yale Univ.

Project Leadership

HEP at ANL

- **Rik Yoshida is the spokesman of the ZEUS collaboration**
- **Dave Ayres is Deputy Spokesman of MINOS**
- **Larry Price is U.S. Project Manager for the ATLAS Hadronic Calorimeter**
- **Bob Blair just finished being U.S. Project Manager for the ATLAS Trigger DAQ System**
- **Steve Kuhlmann is CTEQ spokesman**
- **Jose Repond is Coordinator of the American LC Calorimeter Working Group and will be Chairman of the CALICE Steering Board**
- **Physics Analysis Coordinators**
  - **ZEUS QCD (Sergei Chekanov)**
  - **MINOS Muons (Maury Goodman)**
- **Shift Leaders: ZEUS, CDF, MINOS, STAR**

Project Leadership

HEP at ANL

Detector system Coordinators

- ZEUS Presampler (Steve Magill)
- ZEUS CFLTp (Sergei Chekanov)
- US ATLAS Tile Calorimeter (Larry Price)
  - *Preassembly (Jim Proudfoot)*
- US ATLAS Trigger/DAQ (Bob Blair)
- ATLAS Tile Test Beam Coordinator (Bob Stanek)
- ATLAS Event Data Coordinator (David Malon)
- ATLAS Distributed Database Services (Sasha Vaniachine)
- CDF Calorimeter Coordinator (Larry Nodulman)
  - *Shower max readout (Karen Byrum)*
- CDF Run IIb Calorimeter (Steve Kuhlmann)
- MINOS Near Det. Inst. (Jonathan Thron)
- Near Detector front end readout (Gary Drake)
- NuMI Neutrino Beam Devices (Dave Ayres)
- CALICE (linear collider) HCAL (Jose Repond)

ZEUS Editorial Panel (Jose Repond, Malcolm Derrick)

Physics Community

HEP at ANL

Organize Conferences

- Conference on the Physics of Spin, University of Washington, Seattle, August 4 – 7, 2003
- HADRON 2003, Aschaffenburg, Germany, August 31 - September 6, 2003
- Second International Workshop on Heavy Quarkonium, Fermilab, September 20-22, 2003
- International Conferences on Calorimetry in HEP
- Fourth Circum-Pan-Pacific Symposium on High Energy Spin Physics, Univ. of Washington, Seattle, August 4--7, 2003
- CTEQ Summer School 2004
- High Gradient RF workshop Argonne, Oct 2003
- WIN-03-Lake Geneva Wis. October 2003
- Workshop on Branes and Generalized Dynamics, October 20--24, 2003
- APS Neutrino Study Kickoff Meeting, Argonne, Dec. 13-14, 2003
- Aspen Winter conference Feb 2004
- XXXIXth Rencontres de Moriond, QCD and High Energy Hadronic Interactions, La Thuile,
- APS Neutrino Study Superbeams Group meeting March 3-4, 2004
- International Workshop on Deep Inelastic Scattering DIS2004, April 2004
- 2004 Theory Institute on Supersymmetry, Extra-Dimensions, and Higgs Boson Physics, Argonne National Laboratory, May 24--28, 2004
- LATTICE 2004, the XXII International Symposium on Lattice Field Theory, Fermilab, June 21--26, 2004
- Advanced Accelerator Concepts Workshops June 21-26, 2004 Stony Brook, NY
- TASI lectures 2004, June 2004
- Workshop on QCD on Extreme Environments, June 29--July 3, 2004
- Neutrino 2004
- Vth Rencontres du Vietnam, Hanoi, Vietnam, August 6--11, 2004
- Sixth International Conference on Quark Confinement and the Hadron Spectrum, Sardinia, Italy, September 21--25, 2004
- 2004 Coral Gables Conference, 15 - 19 December, Key Biscayne, Florida
- 2005 Aspen Winter Meeting on Particle Physics, February 13 - 19, 2005
- HADRON2005, Rio de Janeiro, Brazil, 2005
- International Conference on Flavor Physics (ICFP
- 2005), Taiwan
- DIS05 in Madison, WI

Physics Community

HEP at ANL

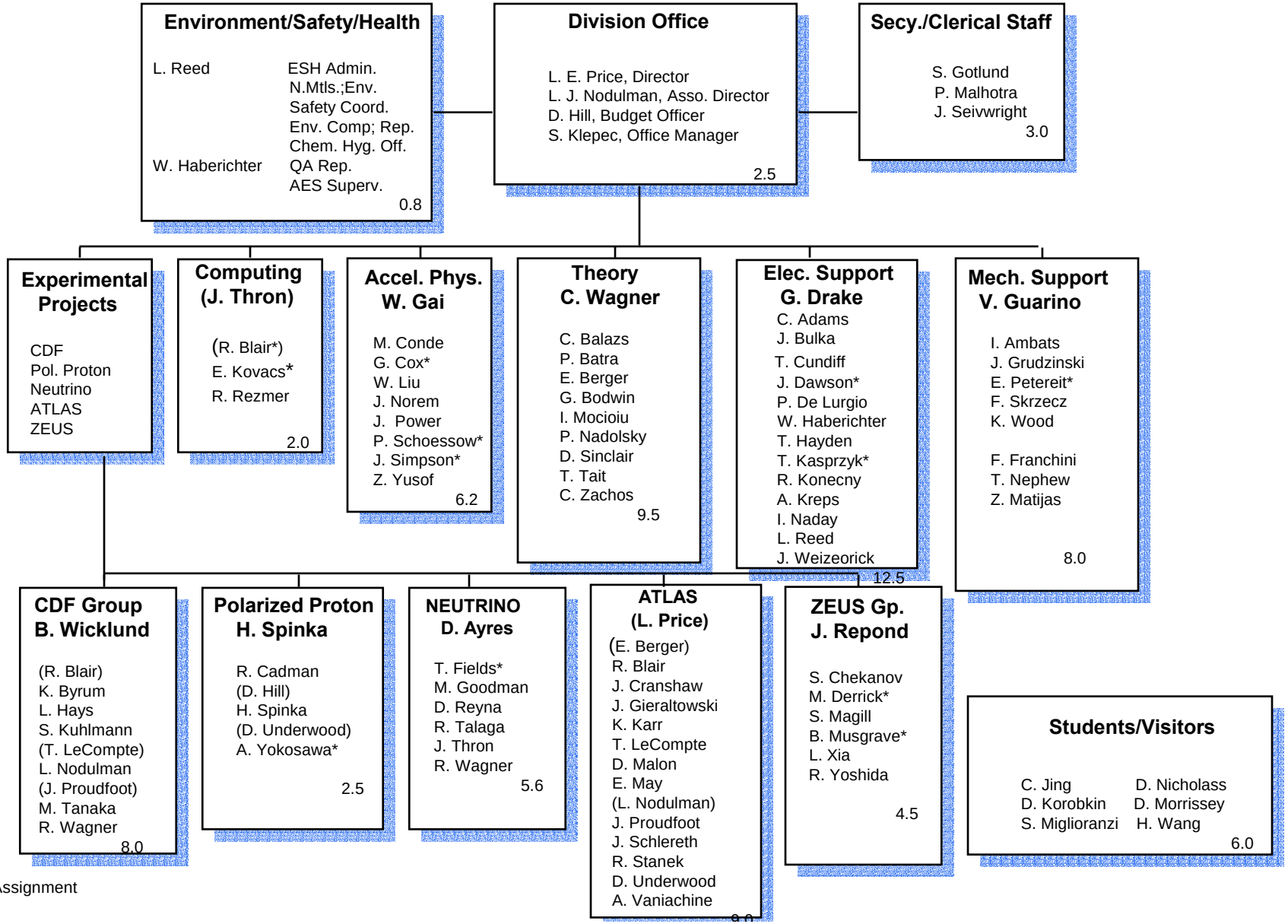
Service on Committees

- DOE Review of SLAC
- ESnet Steering Committee
- FNAL Users Executive Committee
- FNAL Director's ("Temple") Review Committee for BTeV
- DOE CD-1 Review of BTeV Experiment
- Advisory Panel of Jou Phys A: Math Gen (IOP).
- BNL TAC review of the STAR Barrel and Endcap calorimeters
- Coordinated Theoretical-Experimental Project on QCD (CTEQ)
- Andrew Gemant Award Committee, American Institute of Physics
- American Linear Collider Working Group
- Quarkonium Working Group, QWGNET
- HERA III Steering committee
- Particle Data Group
- Editor of Long-baseline neutrino newsletter
- NERSC users group executive committee
- Committee on International Scientific Affairs (CISA), American Physical Society
- NSF proposal panels

ANL HEP DIVISION ORGANIZATION CHART

Version: August 2004

Total Staff: 90 (FTE: 80.1)



*Part time

( ) Secondary Assignment

Division Resources: People

People

- 26 Experimental Physicists
- 6 Theoretical Physicists
- 7 accelerator scientists and engineers
- 8 computer scientists
- 23 engineers, and technicians (mechanical & electronic)
- 8 Postdocs
- 6 Ph.D. Lab/Grad. thesis students
- 6 administrative and clerical staff

Recent Staff Changes

HEP at ANL

Additions

- Puneet Batra — Postdoctoral Appointee
- Jack Cranshaw — Assistant Software Engineer
- Elizabeth Hays — Postdoctoral Appointee
- Dmitri Korobkin — Graduate Student
- Pavel Nadolsky — Postdoctoral Appointee
- Jennifer Seivwright — Administrative Secretary
- Timothy Tait — Assistant Physicist
- (6 Electronics Engineers and Technicians from CIS)

Promotions

- James Grudzinski — Mechanical Engineer
- James Proudfoot — Senior Physicist
- John Power — Physicist
- David Reyna — Assistant Physicist

Departures

- William Ashmanskas — Arthur Holly Compton Postdoctoral Fellow
- Ruth Hill — Executive Secretary
- Jungil Lee — Assistant Physicist
- Brandon Murakami — Postdoctoral Appointee
- Jing Jiang — Postdoctoral Appointee
- Geraldine Servant — Postdoctoral Appointee

Funding Status

HEP at ANL

- **FY2004 Base Funds ($M)**

	Oper.	Eq.
DOE HEP	7.259	0.809
DOE NP	0.430	0.000
	7.689	0.809
(2003)	7.705	0.730
(2002)	7.583	0.745

- **LDRD + Reserve Funds** **$0.744M**

Additional project funding (Est.) **$2.561M**

(2003: $2.588M)

ATLAS, CDF, MINOS, ZEUS, PPDG, ESnet

- **Total FY 2003** **$11.803M**

FY 2004 Base Budget Allocations (K$)

HEP at ANL

	Operating	Equipment
CDF	1055	82
ZEUS	845	30
MINOS	809	317
ATLAS	768	210
Accelerator	1140	105
Theory	1350	
Medium Energy	430	
Polarized	75	
Technical groups	432	65
Total	**7689**	**809**

Budget Realities

HEP at ANL

DOE Budgets are emphasizing operations at SLAC and FNAL, with flat budgets or worse at universities and other laboratories

ANL HEP Budget has been roughly flat in dollars for the last 8 years

There has been a small increase during that time in Accelerator R&D that roughly matches inflation

We are losing people because of budgets

HEP at ANL

FY 2002

- **-5 technicians**

FY 2003

- **-2 physicists**
- **-1 technician**

FY 2004

- **-2 technicians**

FY 2005

- **-2 physicists**
- **-2 technical**

We are working to make the reductions as voluntary as possible.

We are also working with the Laboratory to identify special means of cost savings

Comments from 2000 UC Review

HEP at ANL

Recommendations

- **The Committee felt that the current three-year postdoctoral positions for experimentalists are too short for a young scientist to complete significant projects in the field. At most other institutions, a normal experimental postdoc position is five years with a review after three. A five-year position would allow Argonne postdocs to complete for next-stage positions at both Argonne and other Labs and Universities. Career mentoring should also be an important part of the postdoctoral program. More young postdocs in the experimental areas with a reasonable turnover rate should be a goal.**

As a result of this recommendation, the policy on postdoc tenure at the laboratory has been revised. Postdocs may now remain for up to 5 years based on approval of a plan of work showing the need for additional time to complete a course of research.

- **The Committee has some concern that there is not enough manpower for the ATLAS software project and encourages the Laboratory to take the steps necessary to fill the two currently open computer science positions.**

The ATLAS Software group at Argonne has grown steadily. There are now 5 computer scientists in the group supported by the ATLAS Computing and Software Program and by the Particle Physics Data Grid project that is part of SciDAC at DOE.

Comments from 2000 UC Review

HEP at ANL

- A strong group of postdoctoral scientists is crucial for maintaining the first-rate program at Argonne. Each of the experimental programs needs at least one postdoc during the preparation and analysis stages of the experiment. IN order to maintain and nurture the strong theoretical strength, the number of postdocs should remain at five.

We have had as many experimental postdocs as the budget would permit. CDF has one at present. MINOS had one until he was promoted to Assistant Physicist last year and intends to add another with LDRD funds. ZEUS has been able to attract excellent students from collaborator UCL and has two students now instead of a postdoc. It is now time that ATLAS can responsibly add a postdoc and it is planned to do so in the coming fiscal year.

- The Argonne infrastructure, technical staff, and facilities are a unique resource for high energy physics. They allow Argonne and University groups to collaborate on large construction projects. In order to maintain this infrastructure, the Argonne group needs to identify new projects that can utilize the Argonne facilities after the current set of projects are completed in two or three years. The Committee heard several ideas put forward and encourages the Division to actively pursue some of these options.

The Long Range Plan includes planning for the use of technical groups. Significant technical effort is still being used for (and supported by) ATLAS and MINOS. Increasingly, their effort is being directed toward development activities for new projects.

Comments from 2000 UC Review

HEP at ANL

- **The AWA Group should push forward the high-power tests of dielectric structures. This is an important new line of investigation that holds real promise. The Lab should consider putting more funds in this area as well as pursue collaboration with SLAC and Fermilab.**

The program of testing dielectric structures at high power has moved ahead as fast as the rf systems at collaborator NRL will permit. This is an important component of the present AWA research.

- **The AWA Group should vigorously pursue the two-beam project with the goal of demonstrating acceleration at the 100 MeV in 1 meter level.**

The group is pursuing the 100 MeV in 1 meter demonstration as its highest priority.

Quick Look at the Last 4 Years

HEP at ANL

ATLAS

- Tile Calorimeter has gone from early construction to active installation in the CERN underground cavern
- Final prototype (or first production) ROIB for Trigger being tested in CERN test beam
- ATLAS Software group has grown to 5 professionals and has delivered the database/persistency code for several generations of data challenges, and taken important leadership roles in the ATLAS Computing and Software organization
- A "local" Midwest physics analysis group is being organized with Argonne and UC leadership—data in 3 years!

Soudan 2

- Completed data taking and analysis
- Nucleon Decay, Atmospheric neutrino oscillations
- Searches for dark matter effects, active galactic nuclei,…

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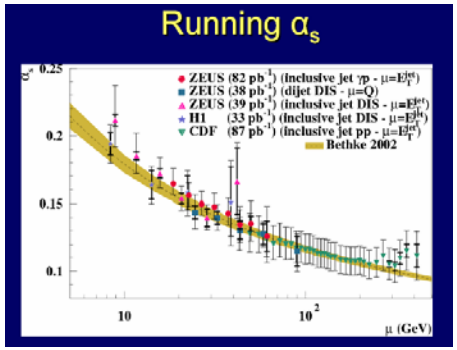
Quick Look at the Last 4 Years

HEP at ANL

ZEUS

- **Physics results**
  - ***Structure functions; diffraction; α_s measurement; c and b production in DIS; prompt photons; pentaquark states, ….***
- **Upgrade of HERA collider and ZEUS detector**
- **Argonne built readout electronics for the new Straw Tube Tracker**



CDF

- **CDF and Tevatron upgrade**
  - ***New shower max readout system***
  - ***Shower max trigger system***
- **Run IIb upgrade**
  - ***New preshower and crack detectors***
- **Physics results**
  - ***Top mass, W mass, B physics (J/ψ modes, $B \to \pi\pi$, $B_S \to KK$ = CKM angle γ, $B_S \to D_S\pi$ ($\pi\pi$) = Mixing X_S); Diphoton production; ….***

MINOS

- **From beginning to build detector module factories to completed installation of both Near and Far detectors. Far detector has been taking data for a year with cosmic rays. Near detector is being commissioned. Argonne has also made important contributions to the building and commissioning of the ν beamline.**

Quick Look at the Last 4 Years

HEP at ANL

STAR

- Collaboration with Indiana University to build an endcap calorimeter that is vital to the spin physics we are pursuing. Installation mechanically complete. Electronics installation and commissioning are proceeding.

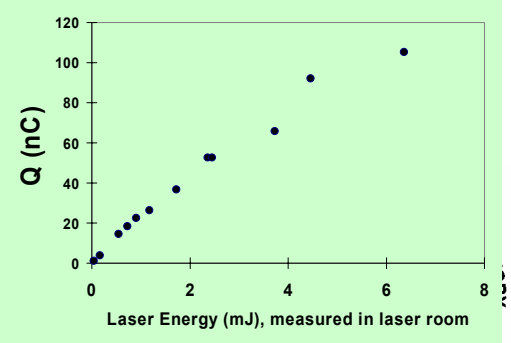
Theory

- Connection with UC through Carlos Wagner has brought two thesis students to Argonne
- 7 international workshops organized at Argonne
- Active work on organizing committees for many workshops held elsewhere
- Physics highlights (Carlos Wagner talk)

Accelerator R&D

- Based on successful demonstration of wakefield acceleration in both collinear and 2-beam configurations, the group has focused on two major developments of the wakefield technique
  - *"Practical" demonstration of acceleration to 100 MeV in 1m path*
    - This has required a major upgrade of their facility, especially the electron gun and laser system
  - *High power tests of externally powered dielectric loaded waveguides in collaboration with Naval Research Laboratory*
- 2 new physics processes affecting electron acceleration discovered (and published)

Charge generated from the new gun



HEP Division Strategic Plan

HEP at ANL

- **Charge to Planning Group**
- **Process: presentations on projects + support tasks (Dec. 03)**
- **Final Divisional review (Feb 10, 2004)**
- **Report (May 2004) includes:**

  executive summary

  interactions with HEP community

  define national laboratory role

  ongoing projects

  - effort transitions from CDF,ZEUS to ATLAS, MINOS
  - advanced accelerator, theory

  new projects shorter term: neutrino, astrophysics

  new projects longer term: Linear Collider (detector R+D, future role)

  - we considered one LC scenario (technology/siting not seen as critical)

  detailed individual project goals

  recommendations

- **Choices => plan based on constant FTE 2004-2010**

Charge

HEP at ANL

- Organize the development of a long-range plan for high energy physics at Argonne National Laboratory. ***The plan should be moderately detailed for a five year period,*** based on a model of costs and FTE levels for each project, starting from the present budget and effort levels in the program. ***Appropriate sizes of technical support groups should be explicitly addressed***. It should provide a broader picture of the evolution of the program over the next 10 years.
- The following assumptions should be taken as the starting point for the plan:
  - 1. ***Base budgets should be taken as flat (constant level of effort) at the level of the FY 2004 AFP;***
  - 2. When initiatives rely on additional funding, that should be indicated explicitly and the scenarios for and likelihood of obtaining such funding should be discussed briefly;
  - 3. ***The national HEP program should be assumed to be that given in the roadmap from the HEPAP Subpanel on Long Range Planning***, as maintained by P5. If ANL plans require modification of the roadmap by P5, this should be noted explicitly;
  - 4. For definiteness in making a timeline, ***assume that the LHC will start data taking during FY 2007 and that construction will start on the Linear Collider during FY 2010***

Main Ingredients in Long Range Plan

HEP at ANL

- **"Existing projects"= CDF, ZEUS, MINOS, ATLAS, AWA, theory**

  CDF/ZEUS efforts phase into ATLAS/MINOS

- **"New Projects"=neutrino, particle astrophysics, LC:**

- Neutrinos (aiming at leptogenesis)

(neutrinos at ANL go back to ZGS E1,12 ft. BC, Soudan, Minos..)

Reactor experiments (Θ_{13})

Off-axis (e.g., NOvA) large detector, monochromatic, Θ_{13}, CP

- Astroparticle ("Precision Astrophysics")

(long term interest dating back to Soudan: Spinka, Talaga, Goodman)

VERITAS (gamma spectrum based at Whipple, complement GLAST)

AUGER (highest energy cosmic rays)

- Linear Collider

Detector R+D aimed at energy flow algorithm test

Process

HEP at ANL

- **Planning Group formed a Steering Committee**
  - *J. Proudfoot (Chair), W. Gai, S. Kuhlmann, C. Wagner, A.B. Wicklund, L. Price (ex officio)*
- **Steering Group developed and implemented the planning process**:
  - Involved all Division scientific staff
  - Held presentations on current and future projects
- **Investigated specific opportunities:**
  - Operations at LHC (ATLAS) and LHC upgrades
  - Reactor and off-axis neutrino experiments
  - BTeV
  - Auger, OMNIS, VERITAS astrophysics projects
  - Linear Collider detector development
  - Plus CDF, ZEUS, MINOS, Accelerator (AWA), theory

- **Held extensive discussions within Steering Committee, the Planning Group and on an individual basis with Division staff**

Divisional Presentations for Strategic Plan

HEP at ANL

Gary Drake (Electronics Support) (Dec. 2, 2003)
Vic Guarino (Mechanical Eng. Support) (Dec. 2, 2003)
Carlos Wagner (Theory) (Dec. 2, 2003)
Maury Goodman (Strictly MINOS) (Dec. 5, 2003)
Maury Goodman (Off axis et al) (Dec. 5, 2003)
Karen Byrum (VERITAS) (Dec. 9, 2003)
Hal Spinka (Auger) (Dec. 9, 2003)
Richard Talaga (OMNIS) (Dec. 9, 2003)
Jose Repond (LC) (Dec. 9, 2003)
Barry Wicklund (CDF) (Dec. 12, 2003)
Jose Repond (ZEUS) (Dec. 12, 2003)
Tom LeCompte (BTeV) (Dec. 12, 2003)
Wei Gai (Accelerator R+D) (Dec. 12, 2003)
Bob Blair (ATLAS) (Dec. 15, 2003)
Jim Proudfoot (ATLAS) (Dec. 15, 2003)
Tom LeCompte (ATLAS Physics) (Dec. 15, 2003)
Tom LeCompte (ATLAS Computing) (Dec. 15, 2003)

Choices Leading to Flat Plan (Synopsis)

HEP at ANL

Strategic plan goal was fixed effort (~33 physicist FTE) FY05-10

Combined requests by project added to ~46 FTE's

Difficult choices:

- -Early reduction of CDF and ZEUS to ramp up ATLAS and MINOS effort
- -Neutrinos: Contribute to Nova and Reactor experiments. By end of 2005, focus on one primary neutrino project, in addition to data taking and analysis on MINOS
- -Astrophysics: Explore VERITAS and Auger upgrades/expansions. By the end of 2005, choose one
- -LC: Continue the important development of digital calorimetry technique as fast as external progress in defining the LC will allow
- -AWA: Continue current focus on dielectric rf generation and accelerating structures. Current budgets will not permit pursuit of new ideas yet.

Effort spreadsheets reflect these compromises.

Summary

In spite of very difficult budget problems…

We have accomplished much in our key roles in the U.S. HEP program

- **Experiments taking data and publishing, experiments in preparation, Theory, Accelerator R&D**
- **Committees, conferences, and other community involvement**

We have a plan for the future

We gain strength from Argonne as a multi-program national laboratory