ANL HEP Division Strategic Plan
Planning Group Report
May 3, 2004

0.0 Executive Summary

The Argonne High Energy Physics program consists of cutting edge research in Experimental, Theoretical, and Accelerator Physics. Argonne does not currently operate an accelerator facility for the HEP program. The Laboratory supports and works closely with university groups in all of our subprograms and projects. The national program benefits strongly from the physics and instrumentation expertise of the staff, from the capable technical groups in mechanical, electrical, and software engineering, and from the multi-program capabilities of Argonne National Laboratory. Our program is aimed at addressing the fundamental questions in physics: electroweak symmetry breaking, matter-antimatter asymmetry, lepto- and baryo-genesis, physics beyond the standard model, and the origin of dark matter and energy.

Currently the experimental research program at ANL HEP is centered on operating (CDF and ZEUS) or soon-to-be operating (MINOS and ATLAS) experiments, and on building and commissioning the ATLAS detector. For Experimental Physics, the strategic plan described below is aimed at preparing first for the transition from CDF and ZEUS to the LHC ATLAS program, where we intend to participate strongly in the physics program (as well as M+O), building on our major efforts on the ATLAS calorimetry, trigger/DAQ, and software systems. We can expect that CDF, ZEUS, MINOS, and ATLAS will be the core of the experimental research program at ANL HEP for the remainder of this decade. In addition to these core efforts, we are investigating new initiatives that have significant uncertainties in timescales and funding. These new initiatives include next generation neutrino mixing experiments, both accelerator and reactor based, astroparticle physics, where our technical expertise is well suited to helping university collaborators, and Linear Collider (LC) detector R+D, where we have focused on development of new calorimeter strategies that will be essential to enable an eventual LC detector to exploit the rich physics at LC beyond the standard model. Our efforts in developing these new initiatives have been generously supported by the Argonne management, through LDRD funding and other means.

In parallel, we plan for the ANL HEP theory group to continue to offer a first class program that will advance particle theory and support the intellectual goals of the experimental program.

We intend to pursue vigorously the advanced accelerator R+D program, with increased collaboration with other ANL accelerator groups centered at APS and Physics. The goals of this program are to study fundamental accelerator and beam-related physics associated with future high energy physics machines: high current electron beam generation and propagation, wakefield acceleration in dielectric and other advanced structures, high power RF generation, material breakdown studies under high fields, and beam instrumentation.

Because of the constraints of funding in the DOE Office of Science and the Office of HEP specifically, the goal for the base plan described below was to craft the best program that could fit in a constant level of effort at the FY 2004 level. We believe that the small size of the Argonne program relative to comparable laboratories without HEP accelerators is an historical anomaly and that, while Argonne is always seen as using its limited funding to maximum effect, its role in permitting university collaborators to build large subsystems of major detectors, advancing particle theory, and inventing the next generation of accelerators would be more effective and more efficient at a larger overall size. We summarize below specific areas that are compromised in the base plan, that we would target for strengthening if we could achieve an increase in funding.

Base Plan

- Careful phasing of growth in ATLAS with faster than optimal reductions in ZEUS and CDF
- Evaluation of two new neutrino experiments (NOvA and Reactor), followed by early choice of one.
- Evaluation of two astroparticle experiments (VERITAS and Auger), followed by early choice of one.
- Development of digital calorimetry for the Linear Collider Detector within the framework of the U.S. LC program.
- Exclusive focus of Advanced Accelerator R&D on the dielectric-loaded wave guide program and especially on the demonstration of 100 MeV acceleration by wakefield-generated rf power.
- Constant level of effort in Theory, with possible recruitment of a junior staff member coming at the expense of a reduction in the postdoc program.

Areas that would be strengthened with increased funding

- Timely addition of postdocs to the ATLAS program for operations and physics analysis, while retaining appropriate strength in CDF and ZEUS to the end of those programs in 2009 and 2007 respectively.
- Strengthening the overall neutrino program through addition of postdocs. We see excellent opportunities for developing and leading a Reactor experiment and/or planning for NOvA, while meeting commitments to MINOS.
- Use of the special expertise of the Advanced Accelerator R&D group to study exciting possibilities in technologies related to their current work, including beam-driven plasma wakefields (first observed by this group, but neglected now for funding reasons), and advanced structures.

1.0 Introduction

The ANL HEP Division undertook a strategic planning exercise starting in October 2003. This planning exercise was organized by a subgroup of the Division Planning Group[1] to define the planning process and formulate the results into a plan for presentation to the Division Planning Group and to the ANL HEP Division Director.

The charge to this sub-committee is given in Appendix I. In essence this calls for both a long range overview and a specific 5-year plan in which the Division program is optimized for a flat level of effort, while maintaining a broad program based on the HEPAP priorities as established by the P5 Panel. The planning process involved all scientific and senior technical staff. It involved meetings of the subcommittee as well as of the Division Planning Group, presentations by members of the HEP staff, a summary evaluation by the subcommittee on the scientific and technical opportunities offered by each project, and finished with an explicit plan for the allocation of technical and scientific staff among the individual projects.

A series of all-Division meetings were held in which advocates of both current and future projects gave their thoughts and perspectives. Guidelines for these perspectives were developed by the subcommittee and distributed to the advocates for each project. Some “natural selection” transpired in the case of possible future projects and, for example, we chose not to evaluate opportunities in the Joint Dark Matter Mission (SNAP at that time). The guidelines and the presentations themselves are available on the public Division Planning web page at http://gate.hep.anl.gov/plan_group/

[1] 1. Strategic Planning Subgroup: J. Proudfoot (Chair), W. Gai, S. Kuhlmann, C. Wagner, A. Wicklund, L. Price (ex officio)

Some of the specific opportunities considered were: Upgrades for ATLAS at the LHC; roles in the future neutrino program (both reactor and accelerator-based research); Linear Collider detector R&D; Linear Collider accelerator R&D; astrophysics and astroparticle physics (VERITAS, Auger, OMNIS); BTeV. Future directions of the Theory program as well as further development of the ongoing experimental programs (CDF, MINOS, ZEUS, ATLAS) and advanced accelerator programs were also considered.

For each of the long term project roles that we have considered, we have benefited from extensive interactions with the high energy physics community. For example, in the neutrino program, we are participating in the APS study on long term options and have hosted two meetings at ANL in December 2003 and February 2004. We helped to found the International Reactor Θ_{13} Working Group and have worked on it jointly with the University of Chicago; we hosted an international meeting in April 2003 and edited the Reactor White Paper Report (Jan. 2004, www.hep.anl.gov/minos/reactor13/white.html). We are participating in the planning for the off-axis experiment (a.k.a. NOvA) that may follow MINOS and hosted a collaboration meeting in 2003; we note that the electronics R+D devoted to the Linear Collider detector is being done in collaboration with the off-axis groups. As for the LC detector R+D, we participate strongly with the US LC community and also have membership in the largely European CALICE collaboration, thanks to our long term program at DESY. In the case of the astrophysics projects, we have consulted extensively with the Auger management, starting with a one-day Auger symposium at ANL in January 2004. We attended the Auger collaboration meeting in Argentina in 2004, and have identified key contributions (some involving our electron wakefield accelerator expertise) that we can make to the overall detector, in addition to helping develop a North American site proposal. On VERITAS, we have had numerous discussions with the VERITAS leadership on the possible role ANL can play in electronics readout for the VERITAS upgrades, and have started laboratory tests with a generous U.C.-ANL funding grant; we have also participated in VERITAS collaboration meetings at the Whipple site. We have had similar extensive interactions with the OMNIS collaboration, which included major improvements in the detector design, and we have hosted OMNIS collaboration meetings. As for the collider physics programs (CDF, ZEUS, ATLAS), our scientific involvement is already well thought out; within ATLAS we are starting to look at LHC upgrades for the period beyond 2010. In general, our planning decisions have been extensively informed through interactions with the community in the specific areas of interest for new projects- LHC, LC, astroparticle, and neutrino physics.

We also included an evaluation of the roles of our technical support groups in the sessions and addressed in our subcommittee meetings issues such as our relationship to programs in Argonne as a whole and possible leveraging of activities.

Following the presentations, the subcommittee met a number of times to review the material presented and to formulate the summary evaluation, the effort level represented by the “requests” and the flat effort plan which we felt best matched the goals and guidelines. The draft plan was presented to the Division Planning Group for comments and largely accepted. The changes suggested in this meeting have been incorporated into the final plan presented here.

The issues raised in the strategic plan were discussed directly with some of the proponents to insure general consensus with the conclusions. An outline of the final strategic plan was distributed to all Division staff and discussed at a Division Meeting held on Feb 10th 2004. No significant changes arose in this meeting.

In Section 2, we present our position on our role in the DOE-HEP programs as a National Laboratory group at a laboratory without a HEP accelerator. In Section 3, we give a summary of our evaluation of the opportunities presented by each project that was considered. In Section 4, we give the main external assumptions, our conclusions and the effort profile which reflects the constant effort base plan.

2.0 National Laboratory Role

A central issue in the development of the Division strategic plan is to insure that the projects and allocation of Division resources match national goals and interests. A set of criteria were established in order to evaluate all projects in terms of the contributions expected from groups at a National Laboratory to the US High Energy Physics program. These criteria are summarized below.

Experimental Groups:

- Contribute unique scientific and technical expertise
- Provide dedicated scientific leadership and management
- Contribute strong support of overall operations (not only for systems built at ANL)
- Provide strong technical and infrastructure support to collaborating university groups and other national laboratories
- Provide strong leadership in exploring scientific and technical options for the future of the national experimental program
- Provide capabilities beyond that of the Division itself by leveraging laboratory resources (such as technical groups, accelerator technology, computing, and supplemental funding such as LDRD funds)

We perceive the technical skills of our support groups to be a central capability of our Division and in evaluating the technical content of future programs we endeavored to identify those with the potential to maintain and enhance these skills.

Theory Group:

- Carry out basic research in a broad range of topics both directly and not directly connected with the present Laboratory experimental program. Expose experimenters to current ideas as well as to alternative ideas that could form the seeds of future projects.
- Support the experimental groups, keeping them up to date with the latest theoretical developments in their respective fields.
- Organize Workshops and Visitor programs, bringing into the laboratory experts in a variety of fields and increasing the visibility of the work of the HEP staff while exposing local scientists to the latest ideas in HEP.
- Contribute to the national HEP program and to the further education of young phenomenologists through dedicated mentoring of postdocs.
- Provide intellectual leadership nationally in proposing new experimental tests of theories and models and in proposing new analyses of existing data, to extract maximum benefit from the investment in DOE facilities.

3.0 Summary Evaluation of Division Projects

As an aid in developing a plan the steering group summarized the scientific merit and strengths of each project in the Division (using material from the presentations as well as the results of discussions with both proponents and colleagues.) In addition, each project advocate provided a concise set of Division Goals for their program (Appendix II.) This material, taken together with the criteria set out in Section 2 above, formed the basis for the keynote statements (**=>** below) and the resulting plan for the allocation of effort among projects. The summary evaluation is presented below. (Note that the physics cases and goals from the Appendix are not repeated in this section.)

Theory:

The Theory Group is making strong contributions to studies of QCD and EWSB and to the phenomenology of standard model and beyond the standard model processes.

Following the reductions in theory staff in the last two years, we anticipate keeping the total effort at 8 FTE's including staff and postdocs.

The possible new joint appointment with UC would strengthen the group, and should be pursued.

=>New appointments should strengthen the work of the theory group in areas which are related to phenomenology and experimental HEP.

CDF:

Provides a discovery potential with at least x20 more data than Run I at highest energies before LHC physics

Has a compelling B physics program

Will make a significant contribution to EWSB through top and W mass measurements

Offers a significant extension of measurements of QCD jets and photons with the extended acceptance relative to the Run 1 detector

Requires substantial Division effort to support ongoing hardware maintenance and operations responsibilities

Is a training ground for LHC physics

=> It would be undesirable for Argonne and for the national program to reduce our participation in the CDF physics program much before the end of operations in FY2009, but it will drop naturally after the first LHC physics paper. If LHC is significantly delayed, CDF manpower doing physics analysis will continue somewhat longer.

ZEUS:

Provides excellent precision QCD physics with x5-8 more data coming from HERA II

Offers a complementary discovery potential for physics beyond the Standard Model

Will give significantly improved knowledge of PDFs and α_s .

Requires Division effort to support ongoing hardware maintenance and operations responsibilities

=> ZEUS effort will decrease naturally as data taking ends in FY2007 and other projects such as the Linear Collider grow.

ATLAS:

We have an excellent plan for participation in ATLAS physics and early publication. We must ensure that there is sufficient physicist involvement to make this happen.

Adding a computational phenomenologist to the group should be considered to further enhance our physics capability

We must insure that GRID computing fits in and supports the overall Atlas effort (data access being seen as a key issue for early physics results)

We have important requirements for technical support groups through 2006 with direct contributions to construction and installation. In all cases we are involved in tasks whose success will directly impact the success of the Atlas detector as a whole.

Technical involvement will be reduced in the M&O era, but ANL technical expertise will remain important.

We are making excellent contributions in the area of computing and software development and these will add to the strength and capability of the Division in the future.

Upgrades are too far in the future to have any impact on strategic planning at this point in time, but must be kept in mind.

=> It is essential that ATLAS have new hires in the Division experimental program in 2005 and 2006 (at post-doc level) to establish a strong physicist involvement in the commissioning and early physics analysis of ATLAS.

BTeV:

Several physicists in the Division have strong interest in B physics but are presently wholly committed to other projects

This project offers some good technical opportunities

The late start compared to LHCb presents some concern in the physics opportunities

=>Therefore we choose to not pursue this project at the present time

Linear Collider:

We have established an excellent program of calorimeter R+D and simulation work developing particle flow algorithms.

The digital calorimeter is a unique detector technology offering the possibility of high precision measurement of jets. The proof of concept test of a digital calorimeter is necessary but expensive.

Funding profiles for all U.S. Linear Collider R+D programs are very uncertain.

Guidance from DOE says there will be no significant funding for R+D until FY06, and this plan shows a slow increase in the manpower in this project starting then.

=> Find a way to insure that the beam test goes ahead and achieves its objectives. Continue (strengthen) electronics design effort on the longer term issue of increasing readout density and reducing cost. If possible, provide assembly effort and M&S from Division base if sufficient external funds are not forthcoming. Of the new initiatives that are under consideration in our plan, our participation in LC R+D is our highest priority.

Neutrino program:

The physics opportunities in MINOS, Off-Axis (NOvA), and Reactor experiments are excellent. We must insure that the new initiatives do not compromise our strong role in the MINOS physics program.

As discussed above in the executive summary, the neutrino program would need additional FTE physicists, not possible in the base plan, to take part in all three programs, even assuming that NOvA's time scale extends well past the Reactor experiment. In the base plan this would not leave enough manpower for any other new project in the Division.

=>A choice should be made between the NOvA and Reactor experiments based on the expected timing and the roles that Argonne is playing. For NOvA we should seek to build a big piece of the detector, along with appropriate leadership responsibilities; for Reactor our goal should be a continued major leadership role.

Advanced Accelerator R&D:

We have a unique capability with the AWA to study two-beam acceleration and dielectric loaded structures.

We should not divert effort from these primary objectives to work in other areas, without additional funding.

We have a good relationship with the Fermilab accelerator group and are collaborating on work associated with electron cooling.

We should participate in the muon cooling experiment at RAL only with explicit funding and a clear role.

We should seek additional funding to expand the group and establish a role in accelerator R&D for the Linear Collider

Note. The increase in FTEs in 2005 represents a hoped-for increase in funding.

=> Focus effort on the AWA demonstration of 100MeV/m and understanding the physics issues. If possible bring Division resources to bear on this to allow effort to go faster.

=> Continue LDRD efforts on Fermilab and LC issues (such as the ongoing LDRD work on electron cooling.)

Particle Astrophysics (VERITAS, Auger, OMNIS):

Particle astrophysics offers exciting and unique scientific opportunities, including: searching for signatures of dark matter, magnetic monopoles or strange quark matter (VERITAS), measurement of neutrino masses (OMNIS) and observation of new particles and particle acceleration mechanisms in the cosmos (Auger). Particle astrophysics experiments such as VERITAS, OMNIS, and Auger complement the measurements that can be done with the accelerator based programs at LHC, NuMI-MINOS, and eventually LC that make up the core of our long range ANL program plan.

There is not enough manpower to commit to more than one long-term astrophysics experiment. VERITAS R+D are currently funded from a UC-ANL Collaborative grant, and we have a good technological collaboration with UC. Several Division members are interested in the physics, with two actively working on the R+D project.

Based on the Auger symposium and subsequent discussions, we believe the Division should pursue the R+D program outlined that day. Several Division members are interested in the physics, and it also has good connections with UC.

There are good aspects to the OMNIS proposal. But it has presently only two interested Division members, one of whom is fully committed to Atlas and CDF. In addition, it has yet to establish a strong university collaboration.

=>All three proposals have significant scientific merit. However, as a Division it is not realistic to maintain efforts in all three areas.

=>Due to the lower physicist interest in OMNIS we recommend that further work on OMNIS should cease and that the OMNIS effort should be redirected towards Auger.

=> Work on both Veritas and AUGER will emphasize R+D in the near term. Near the end of 2005, a decision must be made between VERITAS and Auger. The two efforts should merge at that point to form one strong group.

4.0 The Division Effort Plan through 2010

The primary goal of this planning process is to develop a strategic plan for the allocation of resources assuming a fixed level of effort (near 33 FTE from base funding.) The combined effort "request" for all projects in which Division staff proposed to participate added up to 45 FTE in FY08. All projects being considered had significant scientific merit, and therefore difficult choices were needed to meet the constraint imposed by a flat level of effort. Our flat effort profile is shown in the spreadsheet below. We considered many issues in reaching this plan:

- The scientific loss associated with not participating in a specific project
- The level of scientific interest in each future project
- The minimum level of effort required to take each future project from its present status to one in which the Division would have a significant level of participation
- In our plan, there is never more than 5 FTE available for all the proposed new projects combined, including both neutrinos and particle astrophysics. This number was used to set the scale for the number of concurrent future projects as well as the number in which we could participate in the long term
- Although we assumed that the Linear Collider construction will begin in FY10, with significant R+D money starting in FY05, we also considered the implications of a delay in this schedule.
- The present ZEUS spokesman is from the ANL HEP group. Given this fact, it is unrealistic to consider a significant reduction in the ZEUS effort before 2006
- We made educated guesses about involvement in MINOS and ATLAS upgrades
- We considered the impact of technical work on enhancing the skills in the technical support groups in the Division
- We considered opportunities for enhancement of the technical skill of the scientific staff (e.g. in RPCs and APDs)

In words, this distribution shows the transition from CDF and ZEUS to other projects beginning now with a corresponding strengthening of the ATLAS and LC groups. The plan terminates participation in ZEUS somewhat earlier than in CDF as is representative of their respective running schedules. There are several decision milestones indicated. In particular, due to the limited level of effort available to pursue new projects from the ideas stage, we determined that it would be necessary to choose between Auger, VERITAS, and OMNIS at the conclusion of the present R&D effort At the present level of knowledge, the effort distribution in 2011 and 2012 will be similar to that of 2010.

We recognize that there will always be future developments that are impossible to predict. Therefore, this strategic plan should be updated at the end of FY2004 to reflect the decision points. The direction of research priorities should be re-evaluated at the end of FY2005. At this point in time the transitions from the ZEUS & CDF programs to other projects should be well established. In addition, the situation with respect to the Linear Collider may be clearer.

Below we summarize the staffing plan that corresponds to a fixed level of effort, with completion of existing programs and phasing in of new programs. We have broken out assumed DOE base support and supplemental non-DOE support (from LDRD startup funds, etc.) separately.

Fiscal Year	2004-"Non-DOE HEP"	2004 Plan	"Non-DOE HEP"	2005	2006	2007	2008	2009	2010
CDF									
Physicists		6.2		5.1	4.8	4.0	2.1	1.0	0.5
Other (Mech.)		0.9		0	0	0.0	0.0		
Other (Elec.)		0.3		0.2	0.2	0.2	0.2		
Secretary		0.1		0.1	0.1	0.1	0.1		
ZEUS									
Physicists	0.4	2.8		2.35	1.6	0.85	0.5	0	0
Other (Mech.)	0.5	0.5		0.5	0.5	0.5	0.0		
Other (Elec.)		0.1		0.1	0.1	0.1	0.0		
Students		2.0		2.0	2.0	2.0	1.0	0.0	
Secretary		0.1		0.1	0.1	0.1	0.1		
ATLAS									
Physicists		3.2		4.2	5.0	6.0	7.0	7.0	7.0
Computing	2.0	3.0		3.0	4.0	4.0	3.0	2.5	2.5
Other (Mech.)		2.6		1.9	1.1	1.1	0.5	0.5	0.5
Other (Elec.)		1.6		1.6	0.7	1.5	1.2	1.7	1.6
Secretary		0.3		0.3	0.3	0.3	0.3	0.3	0.3
MINOS									
Physicists		3.7		3.5	3.0	3.0	3.0	3.5	3.5
Other (Mech.)		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Other (Elec.)		1.0		0.1	0.1	0.1	0.4	0.6	1.1
Secretary		0.4		0.4	0.4	0.4	0.4	0.4	0.4
Off-Axis									
Physicists		0.5							
Other (Mech.)		1.6							
Other (Elec.)		0.8							
Reactor									
Physicists		0.7							
Other (Mech.)		0.0							
Other (Elec.)		0.0							
Reactor OR Off-Axis									
Physicists				1.0	1.2	1.2	2.5	2.5	3
Other (Mech.)				1.0	1	1	1.5	1.5	1.5
Other (Elec.)				1.0	1	1	1	0.5	0.5

Fiscal Year	2004- "Non DOE HEP"	2004 Final		2005	2006	2007	2008	2009	2010
Neutrinos (Sub-Totals)									
Physicists		4.9		4.5	4.2	4.2	5.5	6.0	6.5
Other (Mech.)		1.6		1.0	1.0	1.0	1.5	1.5	1.5
Other (Elec.)		1.8		1.1	1.1	1.1	1.4	1.1	1.6
Theory									
Physicists	0.6	9.3		8	8	8	8	8	8
Other									
Secretary		0.7		0.7	0.7	0.7	0.7	0.7	0.7
Accelerator + MuColl									
Physicists	1.4	3.6		4.6	4.6	4.6	4.6	4.6	4.6
Other (Scientist)	0.5	2.2		2.2	2.2	2.2	2.2	2.2	2.2
Other (Mech. Tech)		1.9		2.0	2.0	2.0	2.0	2.0	2.0
Secretary		0.3		0.3	0.3	0.3	0.3	0.3	0.3
Linear Collider									
Physicists	1	1.5		2	2.5	2.5	3	4	4
Other (Mech.)	0	0.1		1.6	0.7	0.7	1.1	1.5	2
Other (Elec.)	0.3	0.1	*1.7*	0.8	0.8			1.0	1.0
New Projects									
VERITAS									
Physicists		0.7		1.2					
Other (Mech.)		0.0		0.0					
Other (Elec.)	0.8	0.0	1.5	0					
Auger									
Physicists		0.0		1.3					
Other (Mech.)		0.0		0.6					
Other (Elec.)		0.0		0.1					
VERITAS OR Auger									
Physicists					2.5	3.0	3.0	3.1	3.1
Other (Mech.)					1.3	1.3	2.0	1.5	1.0
Other (Elec.)					1.0	1.0	1.0	1.0	1
OMNIS									
New Projects (subtotals)									
Physicists		0.7		2.5	2.5	3.0	3.0	3.1	3.1
Other (Mech.)		0.0		0.6	1.3	1.3	2.0	1.5	1.0
Other (Elec.)		0.0		0.1	1.0	1.0	1.0	1.0	1.0
Medium Energy									
Physicists	2.0	0.4		0.4	0.4	0.4	0.4	0.4	0.4
Other (Mech.)	0.6								
Other (Elec.)	0.0								
Secretary	0.2								
ESnet									
Physicist	0.5								
Secretary	0.1								
Physics Division									
Other (mech)	0.8								

Fiscal Year	2004- "Non-DOE HEP"	2004 Final		2005	2006	2007	2008	2009	2010
Support Groups									
Electronics		0.4		0.4	0.4	0.4	0.4	0.4	0.4
Mechanics		0.7		0.7	0.7	0.7	0.7	0.7	0.7
Computing		1.9		1.9	1.9	1.9	1.9	1.9	1.9
Administration		4.0		4.0	4.0	4.0	4.0	4.0	4.0
Totals									
Physicists	6.0	32.6	6.0	33.6	33.6	33.6	34.1	34.1	34.1
Other (total)	4.2	23.3	4.2	23.3	23.3	23.3	22.8	23.0	23.0
Other (Computing)	2.0	4.9		4.9	5.9	5.9	4.9	4.4	4.4
Other (Mech)	1.4	8.3		8.3	7.3	7.3	7.8	7.7	7.7
Other (Elec.)	0.8	4.2		4.2	4.2	4.2	4.2	5.2	5.2
Administration + Secretaries	0.3	5.9	0.3	5.9	5.9	5.9	5.9	5.7	5.7
Students		2.0		2.0	2.0	2.0	2.0	2.0	2.0
	10.5	57.9	10.5	58.9	58.9	58.9	58.9	59.1	59.1

Appendix I

Charge from the Division Director

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 ten 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.

The Steering Committee should make a plan for meetings and presentations to be held during the planning exercise. It should make scenarios at appropriate points in the process for consideration by the Planning Group. At the close of the process, the Steering Committee should provide a draft report for editing and approval by the Planning Group.

Appendix II
Division Goals by Project

CDF

Run IIb calorimeter upgrade (->2005)

- CPR' construction and installation
- Level 2 management, including CEM timing
- Software support for CPR'

Run IIb DAQ upgrade (being negotiated)

Hardware support:

- Shower max electronics
- CEM PM tube maintenance
- Calorimeter SPL role
- Maintain electron/photon code
- Level 2 shower max trigger
- Level 2 isolation trigger
- CEM /CES/ CPR calibrations.

Physics:

- B physics: Bs mixing via SVT trigger
  CKM angle gamma
  Semi-leptonic decays (Bs mixing and calibration)
- Exotic/QCD
  -Search for prompt photon signatures
- Precision EWK Physics:
  -Publish measurements of the W boson mass and width of sufficient accuracy to be a significant contribution to the world average determination. (~40 MeV/c^2)
  -Publish measurements of the top quark mass which dominate the world average; official Fermilab goals for the top quark measurement are 3-4 GeV/c2.

- Demonstrate improved di-jet mass resolution using optimized jet reconstruction
- Establish Higgs sensitivity as luminosity allows.

ZEUS Goals

Support hardware responsibilities until end of HERA II (~2007)

- Maintenance and operation of Calorimeter First Level Trigger Processor (exclusive ANL responsibility)
- Maintenance and operation of Small Angle Rear Tracking Detector First Level Trigger (exclusive ANL responsibility)
- Maintenance, operation and calibration of Barrel Presampler (exclusive ANL responsibility)
- Maintenance of Straw Tube Tracker front-end electronics
- Contribute to the running of the experiment as shift leaders

Analysis effort

- Complete first round of 'Search for Pentaquarks' with refereed publication
- Complete analysis of charm production in dijet events (publish)
- Complete analysis of forward jet cross sections (publish)
- Complete analysis of prompt photon production (publish)
- Complete analysis of multijet production in deep inelastic scattering (publish)
- Initiate second round of Pentaquark search
- Analyze HERA II data sets as they become available (physics topics to be determined)
- Coordinate 'Jets and High Et' physics group
- As members of the ZEUS editorial panel contribute to ZEUS paper writing process
- Participation in upcoming LHC/HERA workshop

Education

- Supervise two graduate students in their hardware responsibilities and analysis effort

Management of ZEUS

- Yoshida will continue to serve as spokesperson of the experiment, at least until the end of 2004
- Derrick and Repond will serve as members of the ZEUS planning group
- Magill will continue to serve as financial officer of the US groups in ZEUS

Exploring the future

- Exploration of the potential of a high energy physics program at HERA beyond Run II

ATLAS Goals

These goals are to set the perspective of where we would like to be in 5 years and 10 years.

Trigger DAQ

- Complete installation of Supervisor / RoI Builder (~8/2005)
- Complete cosmic ray run at CERN successfully supporting trigger supervisor
- Integrate RoI Builder in Atlas 2nd Level trigger and assist in other software development areas in level 2 (~12/2006)

Detector System Construction and Installation, Maintenance and Operations

- Provide leadership and technical staff for the completion of tile calorimeter installation (est. complete in 2 years)
- Provide leadership and technical staff in support of Atlas-wide maintenance and detector operations, consistent with the overall level of US participation (ongoing responsibility)
- Maintain Supervisor / RoI Builder (~8/2005 - until ATLAS as we know it ends or the system is replaced)
- Provide leadership and technical staff for the design and implementation of ATLAS databases

Technical Coordination

- Complete our assigned tasks associated with movement systems in cavern and had over operational responsibility to Atlas (est. complete in 2 years)

Physics

- Establish presence in at least one early physics analysis (~5/2007).). Identify this analysis in ~1 year and consolidate simulation and analysis skills to allow this initial work to be carried out by physicist predominantly at Argonne. These tasks will include strong participation in the combined testbeam and calorimeter calibration, in the development of software tools and in the development of simulation and analysis codes.
- Contribute significant physicist participation at CERN to early years of physics running (~2007-2011)
- Take lead in target analysis and publish when appropriate data is taken (~2008). Ideally this will be one of the first physics papers produced by Atlas.
- Establish strong presence in at least one additional fundamental analysis such as searches for high mass Higgs, or signatures of Supersymmetry. This analysis is expected to produce important results soon after the LHC achieves design luminosity (2009-2010) and will continue thereafter with increased statistical sensitivity.

Neutrino Group Goals

These goals are to set the perspective of where we would like to be in 5 and 10 years

MINOS installation and operation

- Complete our assigned tasks associated with the installation and commissioning of the neutrino beam. (~12/04)
- Provide leadership and technical staff for the Installation of the Near Detector and Installation and Checkout of the near detector electronics. (~2/05)
- Participate in the smooth operation of the MINOS far detector. (2004-2013)
- Contribute significant physicist participation at Fermilab to the early years of near detector operation, calibration and independent physics analysis. (~2005-2008)

MINOS physics

- Lead the effort to measure the underground m+/ m- ratio (~8/04)
- Make significant contributions to atmospheric neutrino analysis based on our knowledge of results from Soudan 2 (2005-2007)
- Take a lead in analysis of the near detector data and publish when appropriate data is taken (~2006)
- Establish a strong presence in at least one beam related neutrino oscillation analysis effort (~2007-2009)

Reactor neutrino Θ13 Experiment

- Exploit our leadership of the white paper for the International Working Group to promote a reactor neutrino experiment, perhaps in Illinois or Brazil. (~4/05)
- Work on a reactor proposal and get it funded. (2004-2006)
- Develop tests for the hardware associated with the calibration and stability of scintillator and phototube response for a reactor experiment. (2004-2007)
- Take part in the reactor neutrino initiative going forward which is most likely to measure a non-zero value of q13. (2006-2013)

Off Axis Experiment

- Lead in the development of a proposal for a new off-axis experiment at Fermilab (2004)
- Design the mechanical structure for a new 50 kiloton detector. (2005-2006)
- Participate in engineering and R&D of readout electronics (2004-2007)
- Develop an appropriate detector R&D program on the active detector for the off-axis program.
- Take part in an off-axis experiment which is most likely to measure CP violation in the neutrino sector.

Other Neutrino efforts and planning

- Take a leadership role in neutrino planning exercises, such as the APS neutrino study and maintain our reputation in worldwide neutrino expertise through the sponsoring of workshops, newsletters, web pages, etc. (ongoing)
- Take early and aggressive participation and leadership in ongoing efforts to develop appropriate long-term neutrino initiatives, such as the Underground Lab, the UNO proton decay experiment, a neutrino factory, the OMNIS supernova project, and other innovative ideas.

Theory Goals (next 5 years)

Concentrate on the most important problems facing contemporary particle physics, paying special attention to new theoretical and experimental developments and being in line with the main activities of the Laboratory and with DOE priorities. The research activities of the group will focus on (but are not limited to):

- Standard Model Physics, with emphasis on QCD, heavy quarks and Higgs Physics, studying the implications for the Tevatron, HERA, LHC Linear Collider physics.
- Beyond the Standard Model Physics: Supersymmetry, Extra Dimensions, Strong Dynamics etc., with emphasis on current Tevatron searches and future connections to LHC and LC physics
- Neutrino physics
- Connections to Cosmology and Astroparticle physics
- Maintain an active, productive postdoctoral program
- Organize regular workshops on significant topics in particle physics

Advanced Accelerator R&D

We will concentrate on the advanced accelerator physics topics related to future high energy physics machines. Particular goals for the next 5years are:

- Demonstrate practical dielectric based accelerator structure using high power X-band RF facility at NRL (2 - 3 Years).
- Using the soon available high current electron beam (18 MeV) for high gradient (> 100 MV/m) test of dielectric and other advanced structures (next 2 - 3 years).
- Development of high energy drive beam (~ 50 MeV) to demonstrate high gradient and sustained acceleration using the wake field method developed at ANL. This will require expansion of the group (one additional RF engineer and a technician). (3 - 5 years)
- Establish a significant role in servicing R&D needs for the linear collider and other users for their HEP related physics experiments (ongoing.)

Linear Collider Goals

Simulation effort

- Continue development of Particle Flow Algorithms.
- Exploration of the phase space of detector design parameters with the aim of optimizing the jet energy resolution
- Simulate the response of the 1 m^3 prototype to particle beams

Hardware developments (FY2004)

- Complete R&D on Resistive Plate Chambers to be used in a Digital
- Hadron Calorimeter
- Complete design of electronic readout system for 1 m^3 prototype section
- Prototype components of electronic readout system
- Develop high voltage system for RPCs

1 m3 prototype (FY2005)

- Construct RPCs for 1 m^3 prototype section
- Construct electronic readout system for 1 m^3 prototype section
- Assemble 1 m^3 prototype section (including HV and gas system)

Test beams (FY2006 and beyond)

- Transportation of prototype section to test beams (FNAL or Protvino)
- Detailed measurements with 1 m^3 prototype section
- Comparison of performance with analog hadron calorimeter prototype section being built in Europe
- Comparison of response with simulation results
- Perform measurements with prototypes of the electromagnetic part of the calorimeter in front of the 1 m^3 prototype section

Calorimeter design (2007 and beyond)

- Develop mechanical design of hadron calorimeter for the Linear Collider detector
- Refine design of RPCs and electronic readout, based on results from test beam

VERITAS – for period 2004-2005

- Perform basic R&D towards using MCPMTs to significantly improve technology of cosmic ray air Cerenkov telescopes.

- Perform basic R&D to utilize Argonne's expertise in building high speed, high performance front-end electronics and trigger, and achieving timing resolution of a few nanoseconds with an emphasis on a low cost solution.

- Enhance the liaison between U. of C. and Argonne.

- Extend the HEP division contributions to smaller cheaper astroparticle physics experiments.

- Determine future Argonne role upon completion of 2 Year R&D phase

Auger Project Goals

Milestones:

- Decision on participation in Auger collaboration meetings, writing of R&D proposal, etc. – few weeks.
- Decision on participation in R&D work – several months.
- Decision on participation in northern site proposal – mid to late 2005.

Goals:

Co-lead the writing of the northern Auger site R&D proposal to DOE and NSF
- Completion by spring or summer 2004

Define the role of Argonne in this R&D, and lead one of the tasks. Possible topics are:
- Detection of ultra-high energy cosmic rays with radio waves. This has not been demonstrated so far. The appropriate hardware would have to be determined/designed, built, and tested with the Argonne Wakefield Accelerator.
- Modification of water Cerenkov tank design for thermal insulation – such insulation is not required at the warmer, southern Auger site.
- Updating water tank electronics to use currently available components.
- Completion late 2005 (or 2006? To include writeup).

Identify significant construction roles for Argonne and assist with writing the funding proposal for the northern Auger site. Possible options are:
- Lead role in the construction of hardware for radio detection of cosmic rays, if this is successfully tested in the R&D phase.
- Primary responsibility for some portion of the site preparation and construction, such as the water purification system, or for a component for the water Cerenkov tanks, such as the solar power system.
- Co-leader role for tank construction.

Work on construction of the northern site detectors (and possible upgrades to the southern site) in one or more roles identified above.
- Begin after approval of the proposal, perhaps 2007 or 2008.

Begin analysis of northern site data, perhaps 2008 or 2009.

OMNIS

OMNIS Goals: Lead-Foil Detector

1. 2004-2005
    - Simulations
    - Work with physicists at OSU on detector optimization
    - Develop mechanical design
    - Complete conceptual design of layered detector structure
    - Determine cost effective way of shaping or stacking lead
    - Develop electronics design
    - Develop conceptual design for APD readout
    - Prototype APD readout
    - Construct scintillator fabrication prototype
    - Investigate feasibility of Gd2O3 as reflective layer
    - Produce co-extruded scintillator bars (with FNAL)
    - Strengthen OMNIS collaboration
    - Take a more active role as steering committee members
    - Submit staged proposal to NSF and DOE to fund OMNIS
    - Submit MRI proposal to NSF to fund SNS calibration experiment

2. 2006-2008

Construction
- Prototype detector for calibration at SNS
- Physics
- Measure neutrino-lead cross sections at SNS

Simulations
- Understand performance of prototype and optimize full-scale detector design

Mechanical design
- Prototype detector design
- Full-scale detector design

Electronics design
- Prototype detector APD readout design & construction
- Full-scale detector APD system design

Leadership
- Continue to build university groups; use calibration experiment as a catalyst
- Continue Active roles on steering committee/ possible spokesperson

Funding
- Submit proposal to NSF and DOE for final stage funding

3. 2009 onwards

Construction of full-scale OMNIS detector & readout system

Operation of OMNIS