

ATLAS

Physics Division

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Outline

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- **Current responsibilities**
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- **Maintenance and Operations**
- **Upgrades**
- **US Research Program**
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Physics Goals

- The rationale for studying TeV-scale collisions has been justified extensively over the last two decades and more.
- The LHC will get there first - discovery.
- Over the last some years, extensive simulation studies have been done by ATLAS and CMS.
- These studies have shown that precise measurements can also be done at high luminosity at the LHC.
- Having seen this development over the last 20 years, the strength of the physics justification for TeV-scale collisions, the LHC, has continued to increase.

Physics Potential - Summary*

- If the minimal Standard Model is correct and the Higgs boson is not discovered previously, it will be found at the LHC.
- If supersymmetry is relevant to the breaking of electroweak symmetry, it will be discovered at LHC and many details of the particular supersymmetric model will be disentangled.
- If the Higgs sector is that of the minimal supersymmetric model, at least one Higgs decay channel will be seen, no matter what the parameters turn out to be. In many cases, several Higgs bosons or decay channels will be seen.
- If the electroweak symmetry breaking proceeds via some new strong interactions, many resonances and new exotic particles will almost certainly be observed.
- New gauge bosons with masses less than several TeV will be discovered or ruled out.
- Signals for extra-dimensions will be revealed if the relevant scale is in the TeV range.

* Taken directly from summary of ATLAS and CMS physics studies, prepared largely by Ian Hinchliffe.

Current Responsibilities

- **Pixel tracking detector**

- ◆ Large roles in mechanics, electronics, module assembly/test
- ◆ Fabricate and deliver end sections of detector and global supporting structure, including part holding interaction region beam pipe.
- ◆ Production of some aspects(mechanics) starting middle of this year and continues until end of 2004. Installation follows.

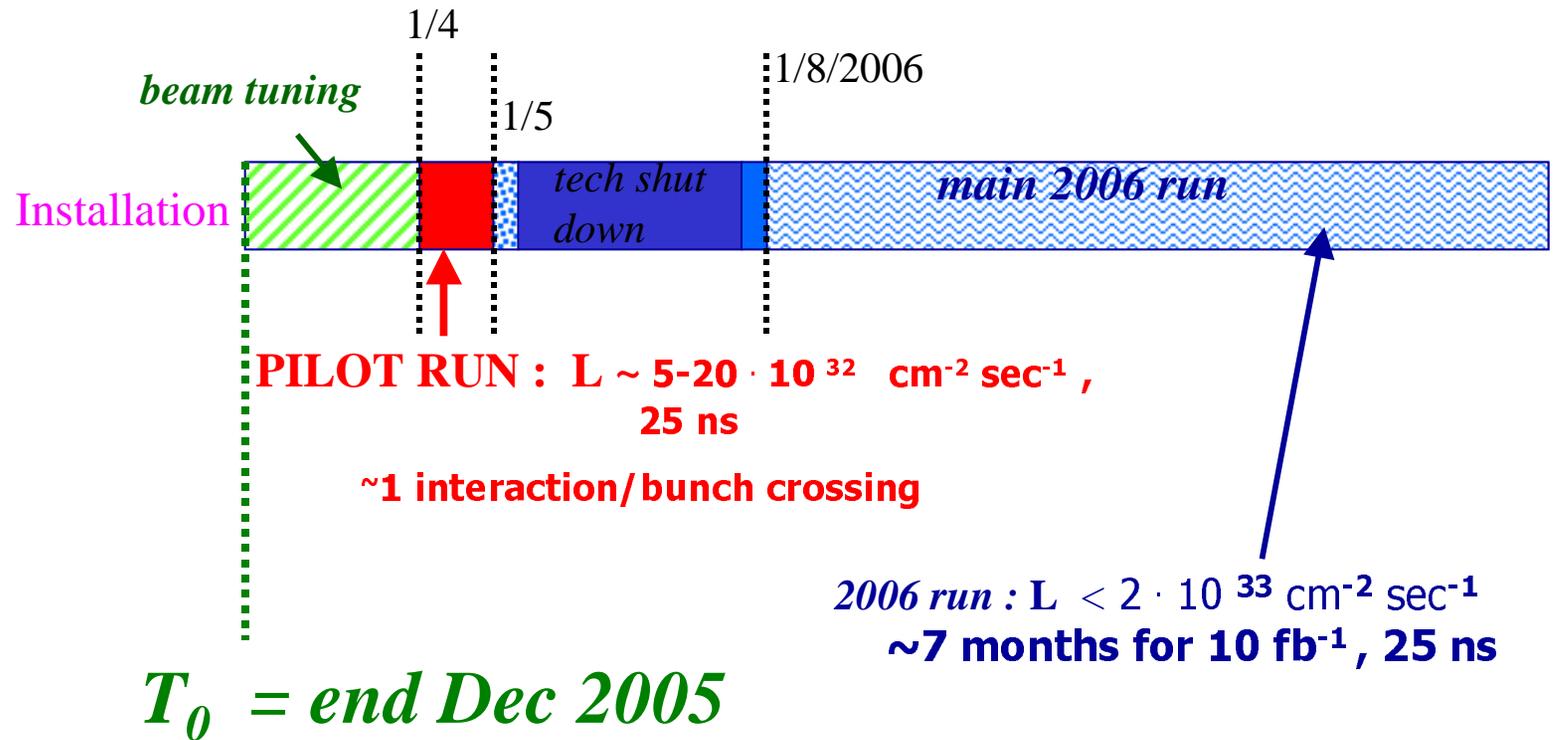
- **Silicon Strip Tracker**

- ◆ Integrated circuit test system, production testing by end this year(using our system at Santa Cruz, RAL, CERN)
- ◆ Module assembly/test, production starts early next year and continues until end 2003.

- **Software/Physics Simulation**

- ◆ Lead role in “framework” software(ATHENA).
- ◆ Major role in physics simulation software and use. First mock data challenge next year.
- ◆ Software work will continue past 1st collisions.

LHC Schedule



Maintenance and Operations

- **ATLAS is expecting to begin the maintenance and operations(M&O) phase of the experiment well before 1st collisions and would like this to begin now.**
- **Formal interactions between CERN and the collaborating funding agencies on M&O and cost overruns are underway.**
- **The LHC experimental program is much too large for CERN to support in the LEP fashion as the host laboratory => substantial finances and manpower from outside CERN will be required.**
- **This is new territory, both practically and politically, and there is considerable uncertainty about how to proceed => progress is slow.**

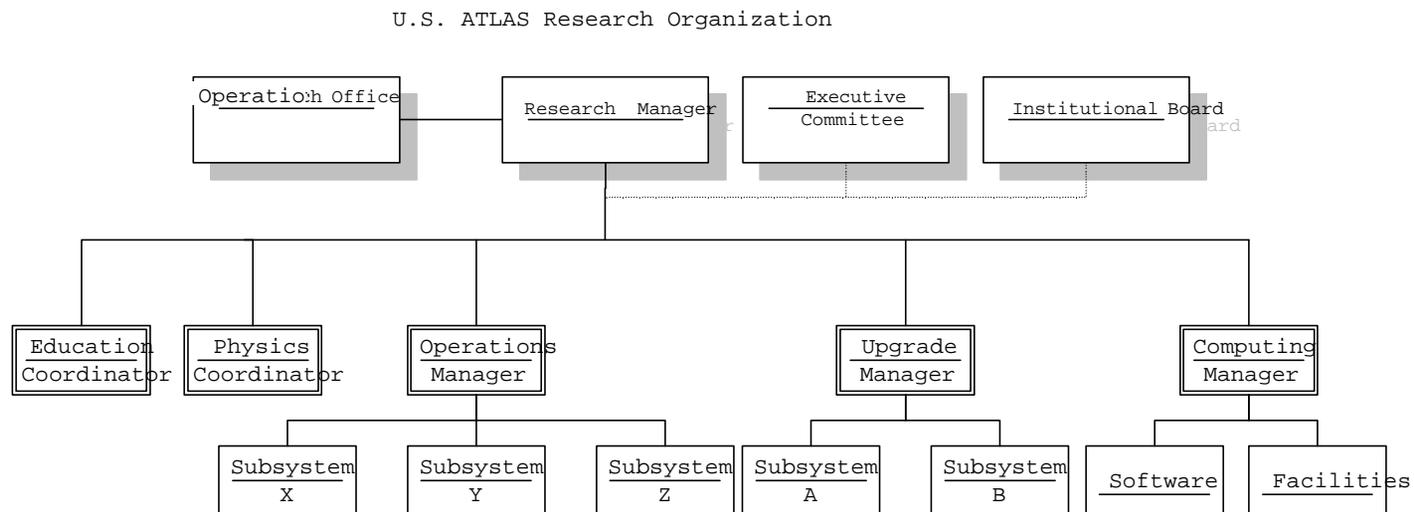
Upgrades

- **Part I - complete the detector(2006/7)**
 - ◆ Current world-wide funding is not sufficient to complete all of ATLAS by the end of 2005.
 - ◆ In the US(perhaps elsewhere), completion will likely fall into the “upgrade” category and hopefully funding will start before 1st collisions, during first installation.
 - ◆ Among the items likely in this category is the pixel detector => continuing LBL responsibility.
- **Part II - after first run(s)(2008 ->?)**
 - ◆ Fix problems not foreseen.
 - ◆ Replace with better technology(pixel B-Layer, trigger,...).
- **Part IIIa - major upgrades(201x -> ?)**
 - ◆ New ideas. Luminosity still around 10^{34}
- **Part IIIb - LHC luminosity upgrade?(20xx)**
 - ◆ Physics potential for $L > 10^{34}$ to be formally documented by Sept. '01 for inclusion in CERN “25 year plan”. Preliminary study done.
 - ◆ Requires very significant detector R&D to take full advantage.

US Research Program

- **BNL will be the US host laboratory, and has been formally charged by the DoE and NSF with managing the US Research Program phase of ATLAS(FNAL has this responsibility for CMS).**
- **This includes M&O, computing, upgrades and facilitation of physics analysis.**
- **A Research Program management plan, including preliminary budgets, is under preparation - see organization chart next page.**
- **First funding will be requested for FY03.**

US Research Organization



Timeline for LBL

- **Now to 2006(1st collisions)**
 - ◆ Complete our “hardware” project responsibilities
 - ◆ Complete our software responsibilities
 - ◆ Prepare for data analysis - physics
 - ◆ Begin maintenance and operation responsibilities
 - ◆ Part I upgrades
- **From 2006 -> 201X**
 - ◆ Physics analysis
 - ◆ Maintain and operate detector(including software)
 - ◆ Complete Part I upgrades(pixels + software)
 - ◆ Part II upgrades(this will require R&D)
- **From 201X -> 20XX**
 - ◆ Best left for retreat in 201X!

Implications for LBL(1)

- **Senior personnel**

- ◆ Present level of senior personnel has declined slightly since we joined ATLAS, need more.
- ◆ Need to add some more youthful energy. Junior faculty /Divisional Fellow(s) starting in 2003. Surely more than one.
- ◆ Open invitation for senior folks to work on ATLAS at CERN. There is a chronic shortage of personnel, particularly in areas of detector integration and software.
- ◆ During installation, commissioning, operation, there will have to be senior personnel at CERN for extended periods. BaBar, D0, CDF..mode of operation will not work at CERN.

- **Postdocs**

- ◆ Currently 2.5, the 0.5 being person in transition to CDF.
- ◆ Number must grow to complete hardware and software responsibilities before 2006, prepare and do physics analysis, meet operations responsibilities and upgrades.

Implications for LBL(2)

- **Technical Staff - Hardware**

- ◆ Very strong team has been assembled for ATLAS, building on developments, particularly electronics and “silicon”, done for CDF, D0 and BaBar.
- ◆ ATLAS has enhanced substantially the LBL mechanical capabilities related to silicon-based detectors.
- ◆ If we want to continue in ATLAS upgrades, we must maintain the core of these capabilities.
- ◆ The critical capabilities reside in both in the Engineering Division and Physics Division. Will continue to need both.
- ◆ Also, ATLAS upgrades alone may not be sufficient (financially) to maintain what we want. Other projects + R&D are needed.

Implications for LBL(3)

- **Technical staff - software and computing**
 - ◆ Professional software expertise will be needed for lifetime of experiment.
 - ◆ Amount will vary with time, but just as in the hardware side, need to retain core of capability.
 - ◆ Again this is divided between Phys. Div and NERSC, but mostly in NERSC.
- **Infrastructure**
 - ◆ Believe hardware infrastructure enhancements(equipment, design software,...) will follow people, but mostly outside Phys. Div.
 - ◆ Keep people, can continue to improve infrastructure.
 - ◆ Local computing infrastructure to do physics analysis not yet really addressed by us(this is OK until next year).

Implications - Bottom Line

- Get more senior people on ATLAS, joining the group or as one-time visitors to CERN.
- Start adding Assist. Prof/Div. Fellow(s) in 2003.
- Ramp up number of postdocs to about 10 by 2006.
- Maintain hardware and software technical core
 - ◆ New mode of operations support will require technical personnel from LBL, both hardware and software.
 - ◆ Develop and work on upgrades(hardware and software).
 - ◆ Synergy with other projects/programs(currently CDF and SNAP) but also R&D, including outside HEP.
 - ◆ Maintain capability within Phys. Division to innovate and lead in technical areas.
- **But must put physics analysis first!**

Funding Sources for LBL

- **Current financial support**
 - ◆ DoE base program
 - ◆ DoE construction project
 - ◆ DoE and NSF support of computing
 - ◆ Infrastructure support(primarily via Eng. Div)
- In the past we have been fortunate to receive LDRD support, and indirect support via DoE SBIR and other one-shot programs.
- **Sources of future financial support**
 - ◆ DoE base program
 - ◆ DoE construction project - until completed by end FY05.
 - ◆ DoE and NSF support of computing, until absorbed into US Research Program(by FY03?)
 - ◆ Infrastructure support(primarily via Eng. Div)
 - ◆ US Research Program funding, hopefully FY03 -> ∞
- There is practically no hope of obtaining funding outside these traditional sources.

Conclusion

- **Fantastic physics potential.**
- **LBL has worked for this for about two decades already.**
- **Finish and operate experiment.**
- **Do physics.**
- **Improve experiment and do more physics.**
- **Doing ATLAS right is a critical test of LBL's viability as a national laboratory over the next decade or more.**