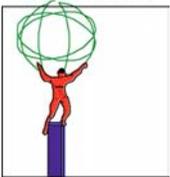


BNL's Role in ATLAS

Howard Gordon

**DOE Annual HEP Review
Brookhaven National Lab
April 27, 2005**



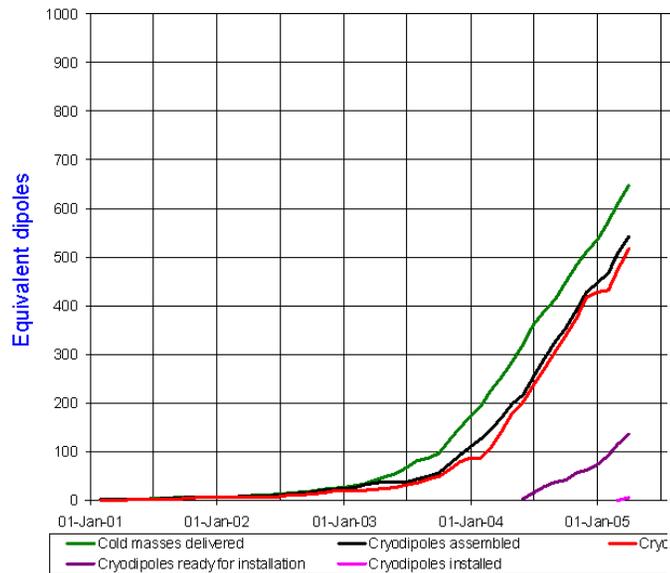
The LHC is ON Schedule for the start of collisions in 2007



LHC Progress Dashboard



Cryodipole overview



Updated 31 Mar 2005

Data provided by D. Tom

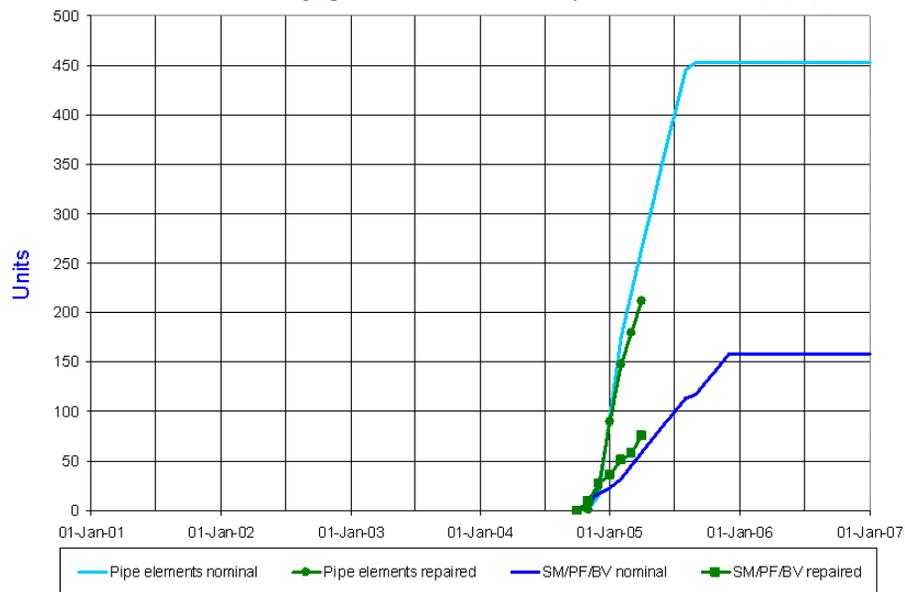


LHC Progress Dashboard



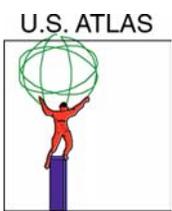
Accelerator Technology Department

Cryogenic distribution line repair



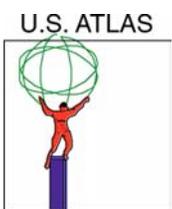
Updated 31 Mar 2005

Data provided by G. Riddone AT-ACR



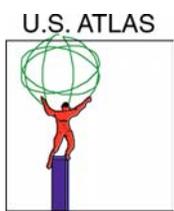
From Lyn Evans' RRB presentation on April 18, 2005:

- **QRL installation is now proceeding smoothly.**
- **The main remaining problem is the fast ramp up of production of service modules to feed the installation sites at the speed required.**
- **Machine installation has started.**
- **Hardware commissioning finished by end June 2007. Ready for beam.**



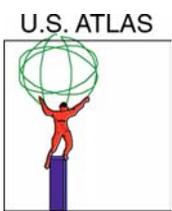
BNL's Leading Roles in ATLAS

- **BNL's Role in ATLAS** **H. Gordon**
 - ◆ Physics & Analysis Center
 - ▲ Also speaking about LHC physics T. Krupovnickas in // Session 3
 - ◆ BNL's Role in U.S. ATLAS Management
 - ◆ Tier 1 Computing Center
- **Construction/Installation/Commissioning** **D. Lissauer (// Session 1)**
 - ◆ Construction:
 - ▲ Liquid argon calorimeter
 - Cryostat and Cryogenics
 - LAr Readout
 - ▲ Cathode strip chambers for the Muon system
 - ◆ Installation & Commissioning
 - ▲ ATLAS Technical coordination
 - ▲ LAr, Muons
 - ◆ ATLAS upgrade – Tracking/Calorimeter/Muons
- **Software and Computing** **S. Rajagopalan (// Session 1)**
 - ◆ Core Software
 - ◆ Analysis and Analysis Support



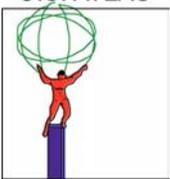
General Approach

- **Construction responsibility matched to unique technical capability at BNL.**
- **Physics & Instrumentation Division were pioneers in R&D for both LAr calorimeter and cathode strip chambers.**
- **Contribution to the analysis builds on the detector expertise in the calorimeter and muon systems.**
- **Main effort in ATLAS upgrade will concentrate on the tracking system. BNL taking an active role with unique developments.**



BNL Hires in the last year

- **5/04 – Stephen Armstrong – Asst. Phys.**
- **5/04 - Sanjay Padhi – Post Doc**
- **1/05 – Kyle Cranmer – Post Doc
Goldhaber Fellow (very competitive)**
- **2/05 – Davide Costanzo – Asst. Phys.**
 - ◆ **(all under 35!)**
(lost 2 FTEs from FY04->FY05 - redirection)



Leading BNL Roles in ATLAS

D. Adams

Distributed Analysis

S. Armstrong

Level 2 Trigger for LAr - Coordinator

K. Assamagan

Analysis Tools Coordinator

D. Costanzo

ATLAS Physics Validation Coordinator

F. Lanni

LAr Upgrade Coordinator

B. Gibbard

International Computing Board (and Grid Deployment Board)

H. Gordon

ATLAS Executive Board, National Contact Physicist

D. Lissauer

Leader of Technical Coordination Project Office (Task A); Upgrade Coordinator for Technical Coordination

H. Ma

LAr Database Coordinator

F. Paige

SUSY Physics Group Co-Coordinator

S. Rajagopalan

(LAr Software Coordinator->) Calorimeter Performance + Event Data Model Architecture; LAr Management Group, ATLAS Computing and Software Management Groups

T. Wenaus

LCG Applications Area Coordinator (3 years ended on Feb. 28, 2005 – did good job)

Now full time ATLAS Database Project Co-Leader (May 1, 2004) and as a result is on the Software Management Group

H. Takai

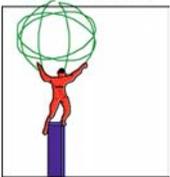
Co-Coordinator Heavy Ion Physics Group

V. Polychronakos

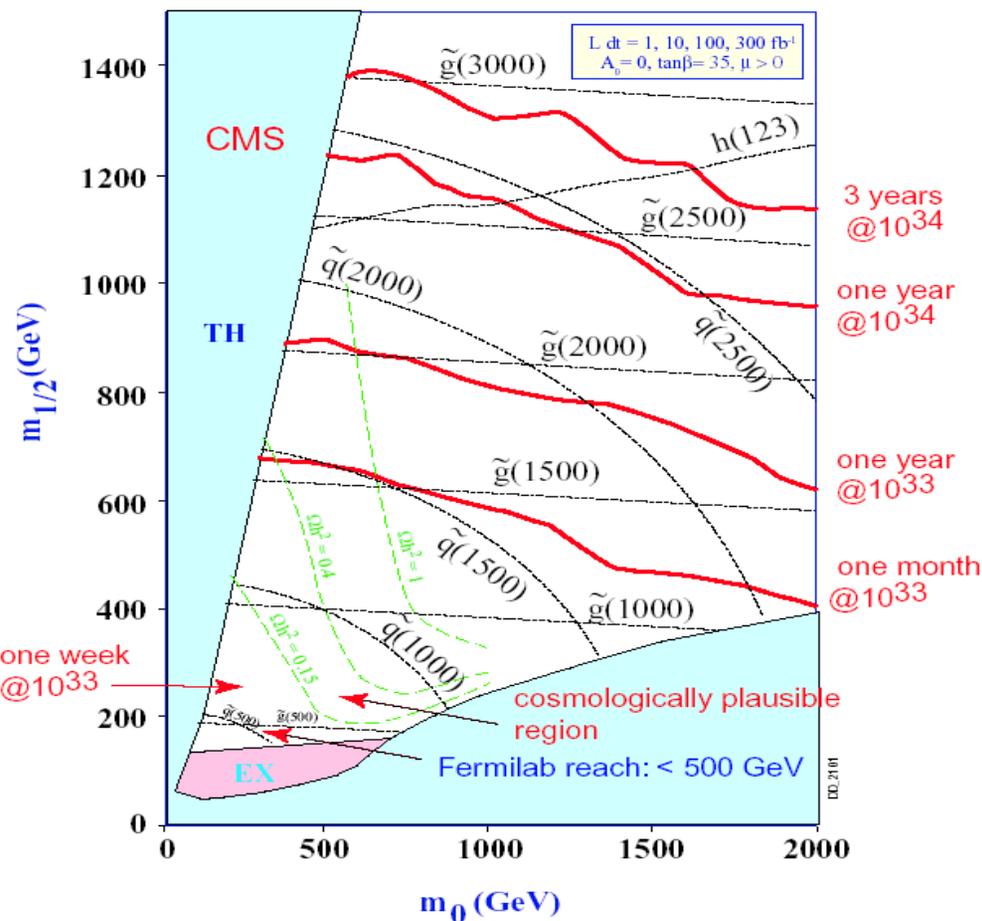
ATLAS Muon IB Chair (elected) and CSC Leader

Srini will discuss the rest

H. Gordon, BNL DOE Annual HEP Program Review, April 27, 2005



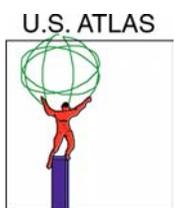
SUSY Reach



The cosmologically interesting region of the SUSY search will be covered in the first weeks of LHC running, and the 1.5 to 2 TeV mass range for squarks and gluons will be covered within one year at low luminosity.

The LHC should be able to establish the existence of SUSY and open many avenues to study masses and decays of SUSY particles, if $m(\text{SUSY})$ is less than a few TeV.

See Tadas' talk for more details



An example of Physics Studies at BNL

e/μ Analysis at SUSY Point SU1

Davide Costanzo, Frank E. Paige (BNL)

SU1 is coannihilation point characterized by small mass splittings:

$$\begin{aligned}M(\tilde{\chi}_2^0) - M(\tilde{\ell}_L) &= 8.5 \text{ GeV}, & M(\tilde{\ell}_R) - M(\tilde{\chi}_1^0) &= 17 \text{ GeV} \\M(\tilde{\chi}_2^0) - M(\tilde{\tau}_2) &= 6.6 \text{ GeV}, & M(\tilde{\tau}_1) - M(\tilde{\chi}_1^0) &= 9.5 \text{ GeV}\end{aligned}$$

Hence soft leptons and τ 's.

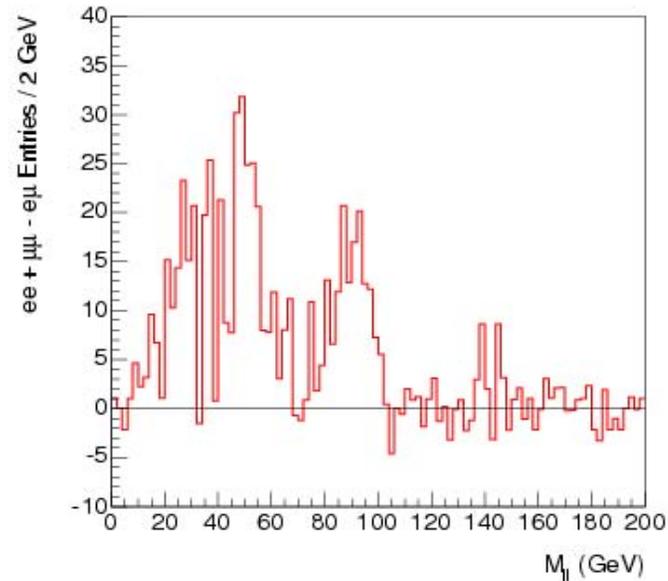
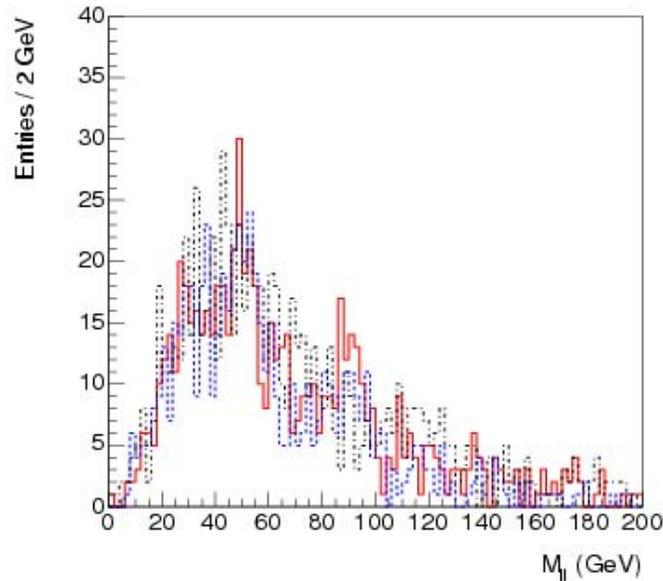
Have analyzed 66k events using `SusyPlot` with AOD's from Athena 10.0.1. Concentrate on e/μ selection with no SM cuts, background, pileup.

Muons: Default cuts are $p_T > 10 \text{ GeV}$, $\eta < 2.5$, and best $\chi^2 < 10$. Added isolation cut $E_T < 10 \text{ GeV}$ in cone $R = 0.45$.

Note isolation in `Muon.h` is E , not E_T , so divide by $\cosh \eta_\mu$. Calculated at EM scale from calorimeter only.



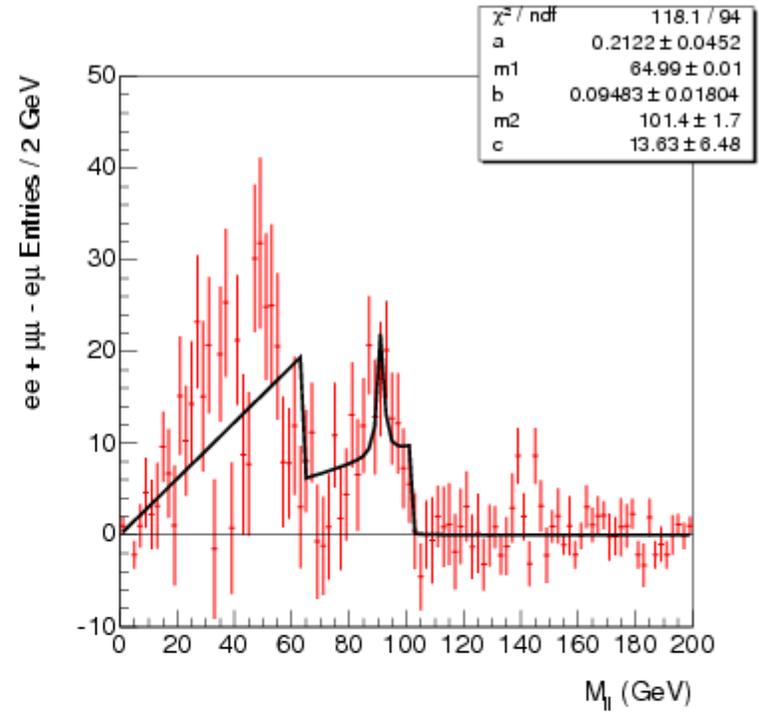
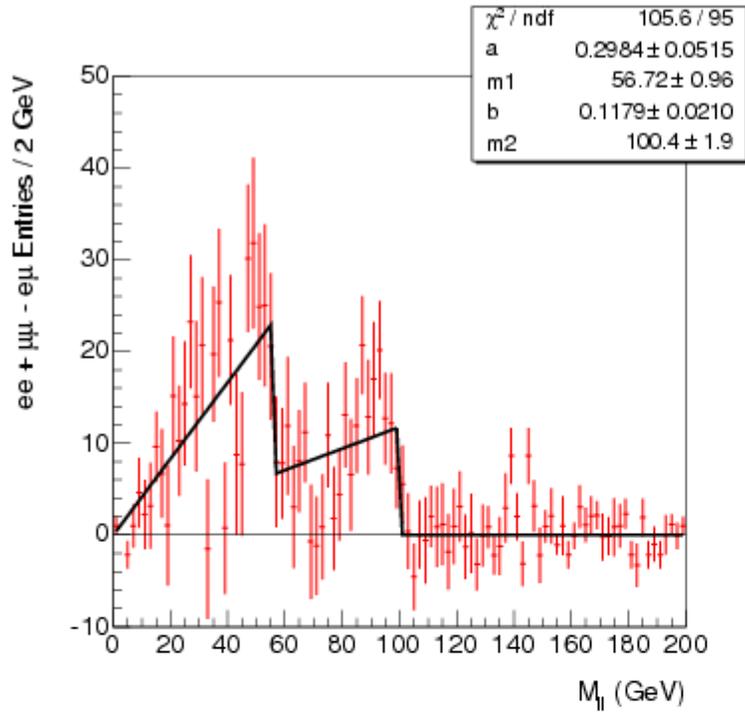
Dileptons: Plot $\mu^+\mu^-$, e^+e^- , $e^\pm\mu^\mp$ and $e^+e^- + \mu^+\mu^- - e^\pm\mu^\mp$:



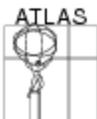
Note large $e\mu$ background at this point.

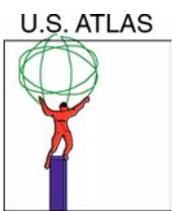
Observe two edges plus (perhaps) Z peak. Fit including Z is rather unstable, so just fit with two edges. Reasonable agreement with expected 58.2 GeV and 100.9 GeV:





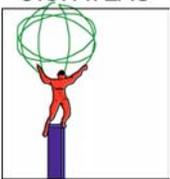
Have not yet smeared fitted distributions with resolution $\sim 1\%$.





U.S. ATLAS Physics Model is Evolving

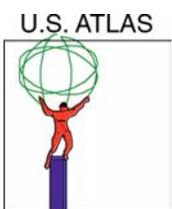
- The Collaboration has a taskforce working to produce a “white paper”
- No attempt to “manage” physics but provide support
- Elements of the Model include:
 - ◆ A corridor of expertise
 - ▲ Analysis Support Group
 - ◆ Working Groups
 - ◆ Centers – at least at BNL



Analysis Support Group, Led by Hong Ma

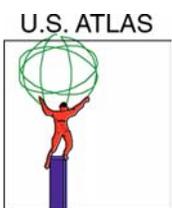
- **Provides**

- ◆ **Up-to-date information on sub-detectors and software components**
- ◆ **Maintains web pages (e.g. Tier 1)**
- ◆ **Analysis software tutorials**
- ◆ **Solve software problems and hold meetings as a forum in which to discuss technical problems**
- ◆ **Develop and follow-up analysis plans with US institutions to determine impact on resource allocation – provide input to management**
- ◆ **Either host visitors or make visits to institutions to help with analysis environment set-up etc**
- ◆ **Presence at CERN to support US activities there**



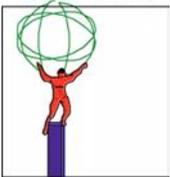
Working Groups

- **Particle ID – 1st priority**
 - ◆ e/gamma, Jet-Et-Miss, Muon ID, (b-tagging), Trigger
- **Physics - next**
 - ◆ Standard model, (B physics), (Top), Higgs, SUSY, Exotics, Heavy Ions
- **Role**
 - ◆ Technical support and facilitation of analysis activities of US physicists
- **Questions:**
 - ◆ Detailed mechanism for appointment of conveners?



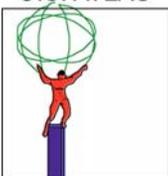
A Physics Analysis Center at BNL:

- BNL has:
 - ◆ Intimate knowledge of the detector technology and performance
 - ◆ The large success of the cost effective RCF has led to the U.S. ATLAS Tier 1 Computing Center
 - ◆ There is CORE Software leadership [at BNL](#).
 - ◆ Internationally recognized leading theorists who have simulating LHC physics.
 - ◆ Altogether a critical mass of people and space for visitors
- This BNL Center has become a place where U.S. physicists come with their students and post-docs to learn everything needed to be able to do independent analysis at their home institution.
 - ◆ Members of the Center have been conducting Tutorials, doing regular consulting, leading meetings (in person and phone/video)
 - ◆ There are some regular visitors
- The Center needs more staff (~10) to become fully effective
 - ◆ This could come from DOE when the U.S. ATLAS Collaboration sets its priorities



Activities at the Physics Analysis Center at BNL in the last year

- **Tutorials (~number of attendees)**
 - ◆ **North American Physics Workshop (45); CERN – Analysis Tools (50); SMU; Tufts; UC-Irvine (three aspects)**
- **Regular Consulting: Hampton, Tufts, Harvard, ANL, Columbia, SMU, Iowa State, UT-Arlington, Alberta**
- **Physical Meetings at BNL: Muon Working Group 11/04; e/γ Working Group; Jet/Miss E_T Working Group**
- **Phone/video Meetings (ongoing): U.S. ATLAS Analysis (bi-weekly); Muon (monthly); e/γ (monthly)**
- **Resident at BNL: A. Khodinov (Stony Brook); S. Willocq (U. Mass, Amherst)**
- **Preparing a large meeting room with state of the art audio/video system**



U.S. level working
group meetings
Since First North
American ATLAS
Physics meeting in
Tucson, Az in
December 2004.

 2005

April 2005

-  28 [USATLAS Physics Analysis](#) New!
-  27 [US-ATLAS Exotics Meeting](#)
-  26 [US ATLAS egamma phone meeting](#) New!
-  15 [US-ATLAS exotics phone meeting](#)
-  12 [US ATLAS Muon Software Meeting](#)

March 2005

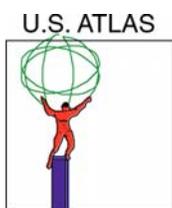
-  31/03 - 01/04 [Beyond the Standard Model Workshop at Columbia](#)
-  29 [US ATLAS egamma phone meeting](#)
-  24 [US ATLAS Monthly Computing meeting](#)
-  17 [USATLAS Physics Analysis](#)
-  01 [US ATLAS egamma phone meeting](#)

February 2005

-  17 [USATLAS Physics Analysis](#)
-  10 [US ATLAS Muon phone meeting](#)
-  03 [USATLAS Physics Analysis](#)
-  02 [North American Jet/EtMiss Reconstruction Meeting](#)
-  01 [US ATLAS egamma phone meeting](#)

January 2005

-  27 [US Monthly Computing Meeting](#)
-  20 [USATLAS Physics Analysis](#)
-  13 - 14 [USATLAS egamma Working Meeting](#)



U.S. ATLAS Physics Meetings

Date/Time: Thursday 17 February 2005 from 16:00 to 17:00

Location: US EST

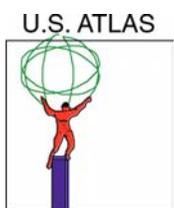
Chairperson: Hong Ma

Description: *Video: ip-based VC, dial in number = 828727
Phone: 1-510-883-7860. at the announcement dial 828727#
BNL Video Conference Room: Rm 2-52, Bldg 515
CERN Video Conference Room: Building 188, 3rd floor, Room 08
(Michigan's Video Conference Room)*

Thursday 17 February 2005

16:00 **Jet Response Using Etmiss Projection (20')** (
[more information](#)) [Kehoe, R](#) (SMU)

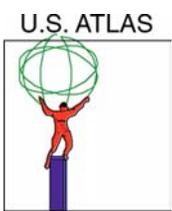
16:20 **W and Z validation and muon detector calibration
and alignment (20')** ([transparencies](#)) [Zhou, B](#) (Michigan)



e/ γ Working Group

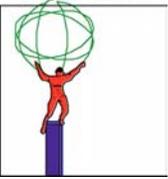
- **Tuesday 26 April 2005** e/ γ Working Group – Led by Hong Ma (BNL)

15:00	Cluster corrections (10')	Scott Snyder/Stathes Paganis <i>(BNL/Madison)</i>
15:10	Photon Conversion (10')	David Joffe/Yongsheng Gao(SMU)
15:20	Electron Brem recovery (10')	Alex Khodinov/M Rijssenbeek <i>(Stony Brook)</i>
15:30	H-matrix (10')	Hyeonjin Kim/ Jae Yu (UTA)
15:40	Electron ID (10')	Ning Zhou/ Kamal Benslama/J. Parsons <i>(Columbia)</i>
15:50	Soft electron (10')	Jim Cochran/Srini Rajagopalan <i>(Iowa State/BNL)</i>



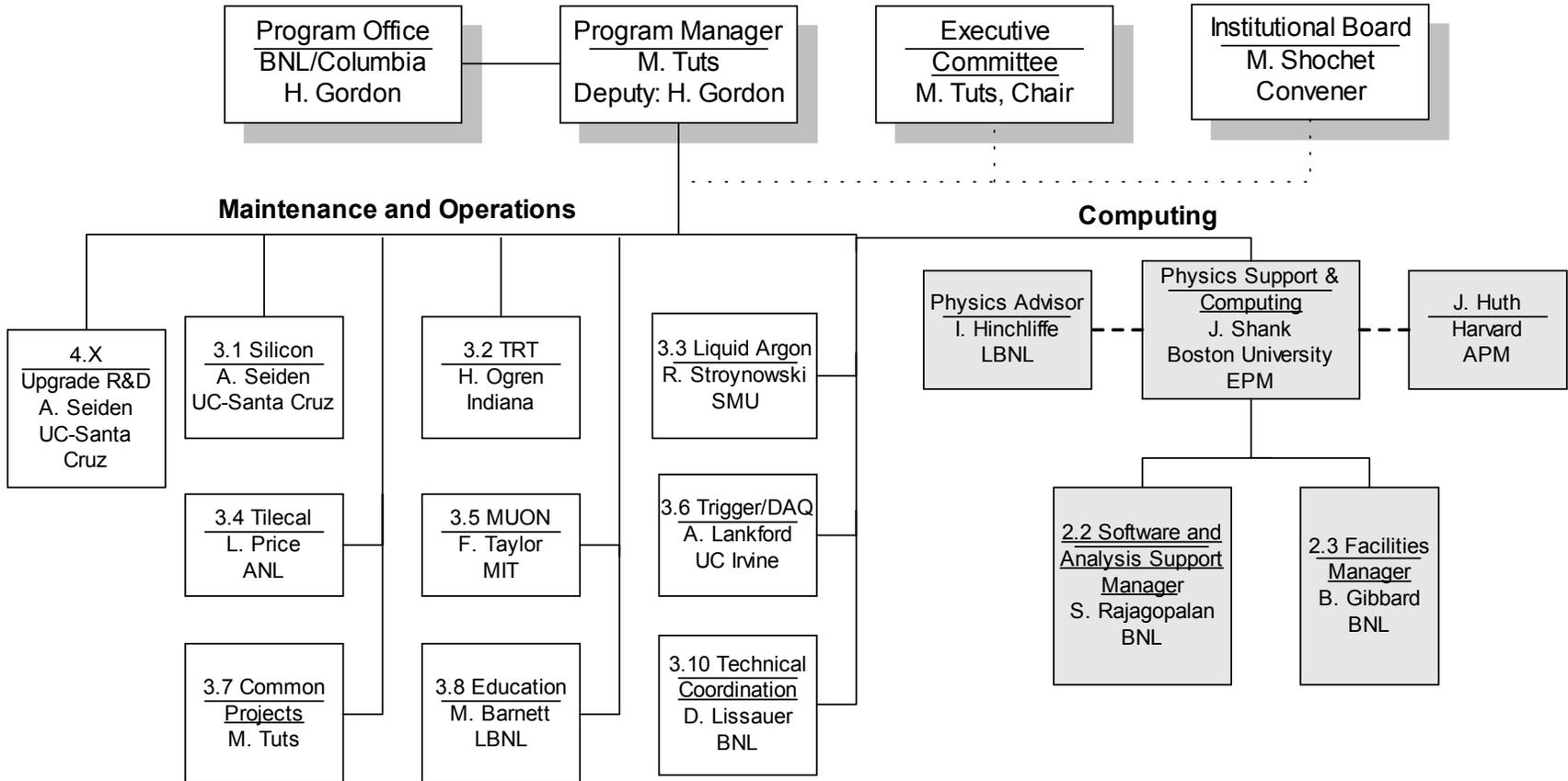
U.S. ATLAS Project and Research Program Management

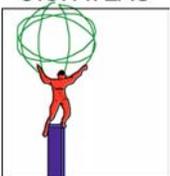
- **BNL is the Host Lab for the 33 U.S. institutions in ATLAS**
- **We have (almost) constant reviews**
- **We are active in the transition from a successful Construction Project to the Research Program which includes:**
 - ◆ **M&O – consisting of pre-operations and commissioning**
 - ◆ **Computing**
 - ◆ **Upgrade R&D**
- **We are responsible for (monthly) reports, budgets, MOUs, and other exercises**
- **We are revising our survey of U.S. ATLAS Institutions to give further insight into the Research Program and the needs of the “Core Research” Program**



Research Program Organization

U.S. ATLAS Research Program Organization as of April 2005





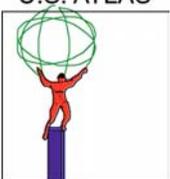
UX15 cavern

- Cryo equipment installation on USA wall in progress on level 6 (supports of flexible lines).
- Electrical general services in progress (100% complete on HO, in progress on HS)
- Mixed and chilled water piping in progress (welds pbs)
- 4 TB coils in UX15, barrel calorimeter electronics and services installation in progress
- Approx 20 muon chambers installed in sector 12 and 14

Coming up soon:

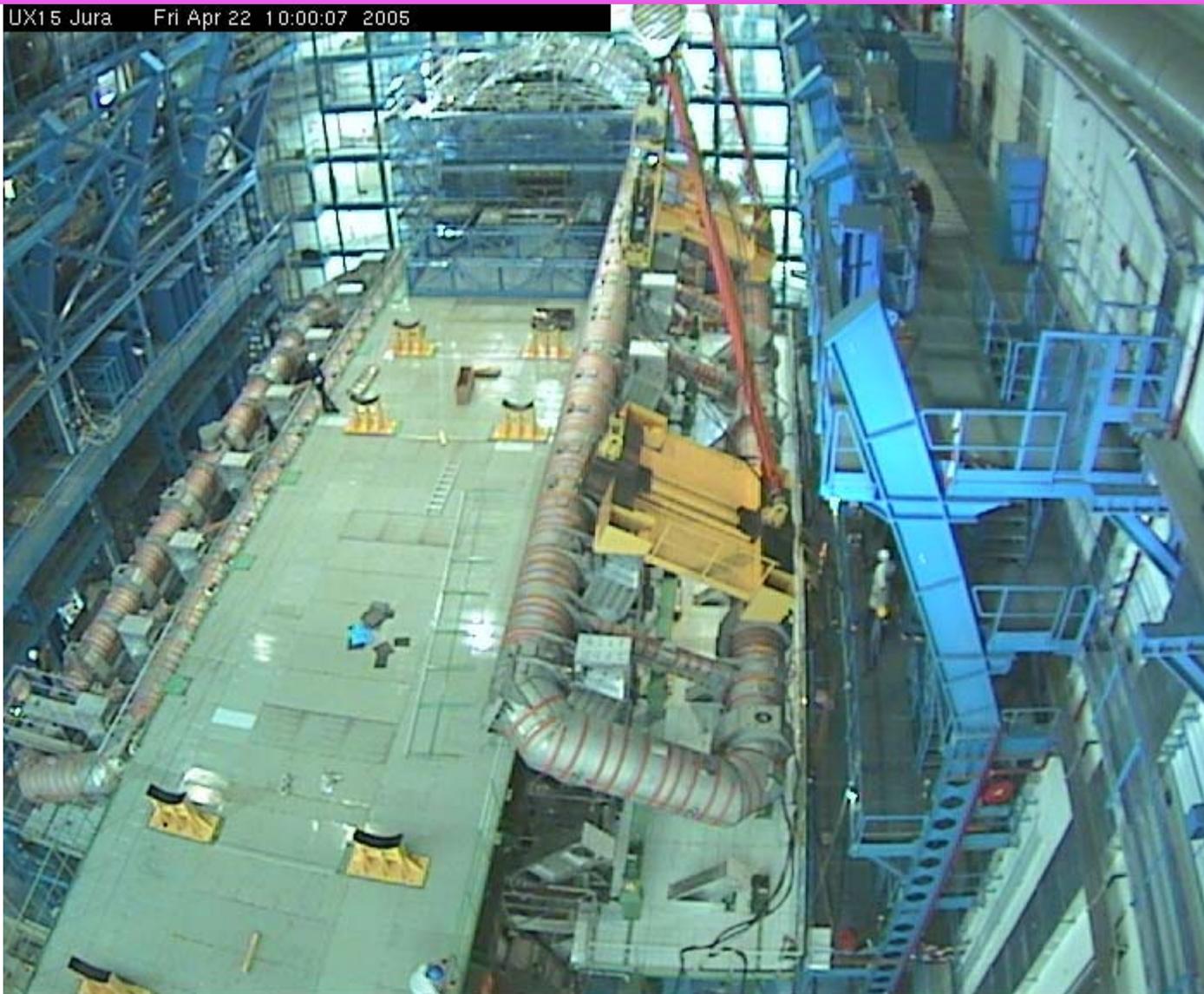
- Lighting in HS and on the vault
- Cooling units for detector
- Muon chambers sector 10
- Stainless steel cable trays

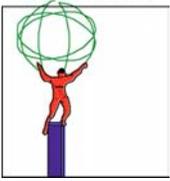




ATLAS is being Installed (4th Barrel Toroid Coil put into place on April 22, 2005

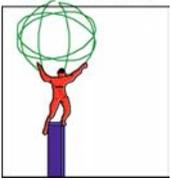
UX15 Jura Fri Apr 22 10:00:07 2005





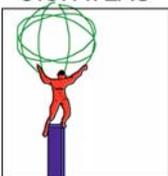
U.S. ATLAS: CD-4A – the Overall Picture

Subsystem	WBS	Deliverable Description	% Complete Jan. 31, 2005 (BCWP)	<u>CD-4A</u> <u>CD-4B</u> %	Projected Cost through FY05 (k\$)
Deliverables	WBS				
Silicon	1.1	Total Silicon Projected CD-4A Cost	92%	99%	23,702.8
TRT	1.2	Total TRT Projected CD-4A Cost	99%	100%	11,776.6
Liquid Argon	1.3	Total LAr Projected CD-4A Cost	95%	100%	47,524.2
Tile	1.4	Total Tile Projected CD-4A Cost	97%	98%	11,552.3
Muon	1.5	Total Muon Projected CD-4A Cost	93%	99%	29,985.5
TrigDAQ	1.6	Total TrigDAQ Projected CD-4A Cost	47%	62%	5,078.6
Common Projects	1.7	Common Projects	91%	100%	11,979.1
	1.7	Common Projects FY05	0%	100%	5,534.0
Education Project	1.8	Education	100%	100%	124.7
Management Technical Coordination	1.9	Project Management	99%	100%	8,279.0
	1.10	Technical Coordination	100%	100%	3,094.2
		US ATLAS Construction Total @ CD-4A	91%	97%	158,631.0
		US ATLAS Construction 97% Target			158,631.0



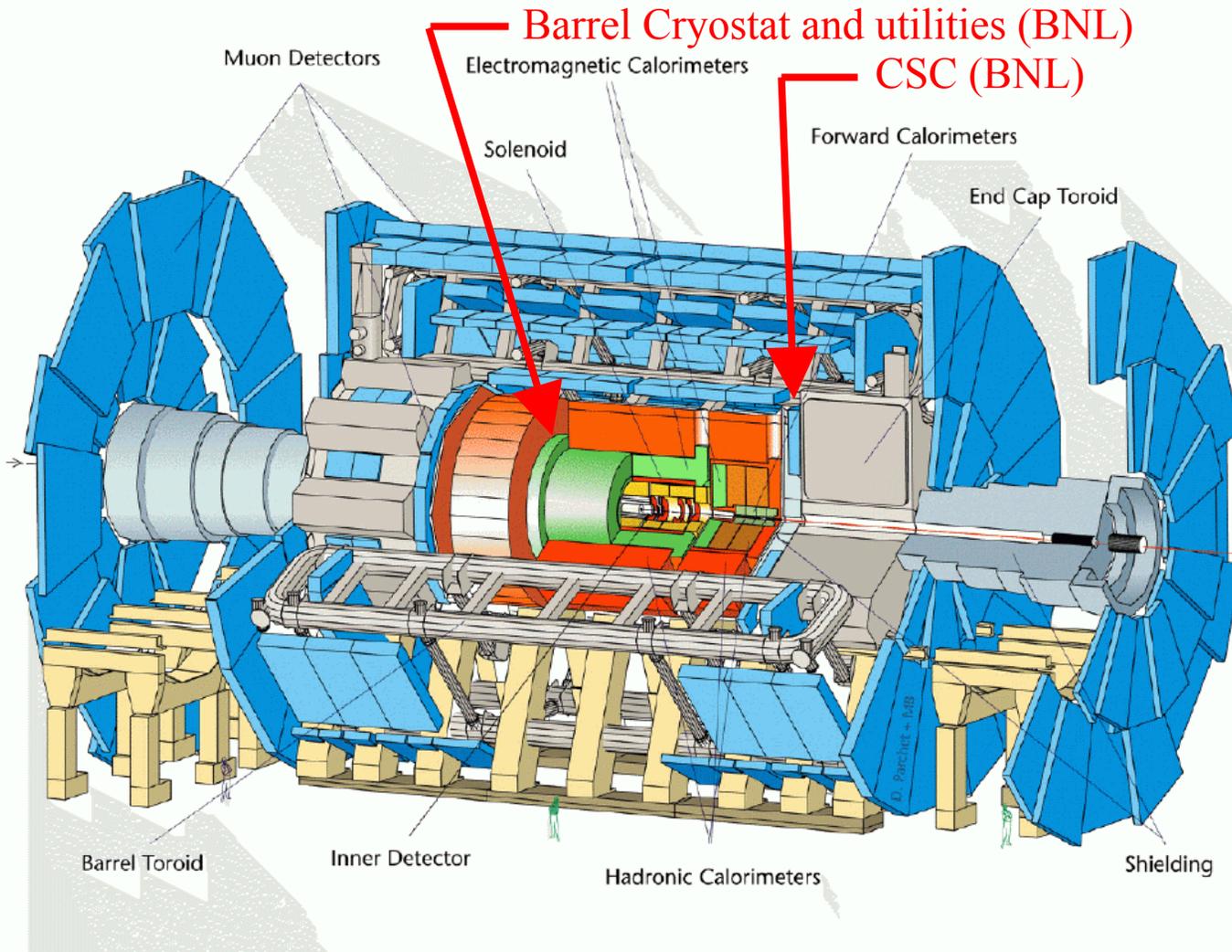
Pre-operations (part of M&O) is Active at CERN

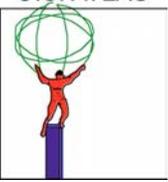
- **TRT – Barrel Modules are at CERN and in pre-operations**
- **Liquid Argon –**
 - ◆ **The Barrel Cryostat has been pre-operated in Building 180 and now is in the cavern**
 - ◆ **Electronics is being commissioned**
- **TileCal modules are all at CERN and are in pre-operations**
- **Muon chambers are at CERN and are in pre-operations**



BNL Deliverables to the ATLAS Experiment

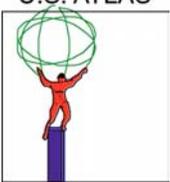
021248-CK89/97



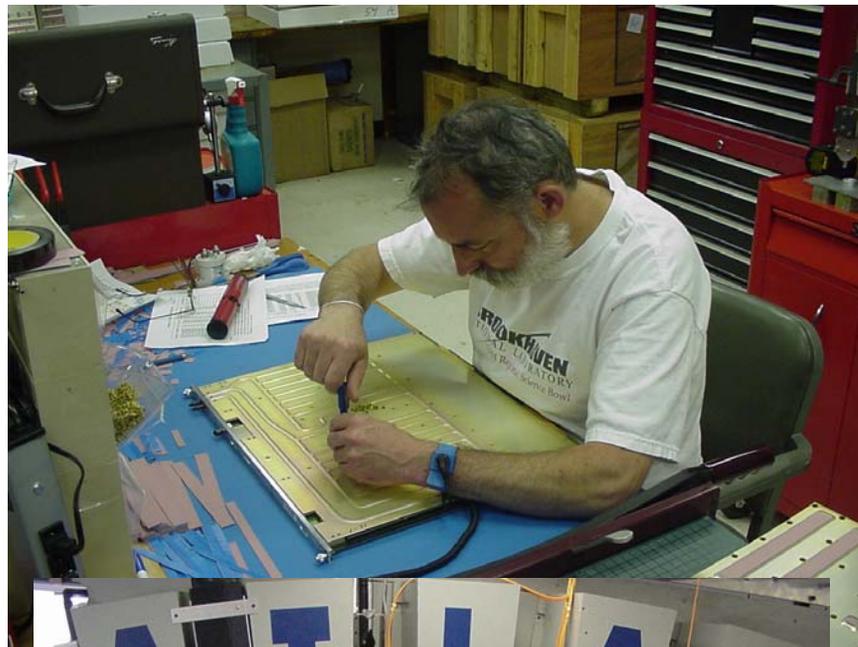
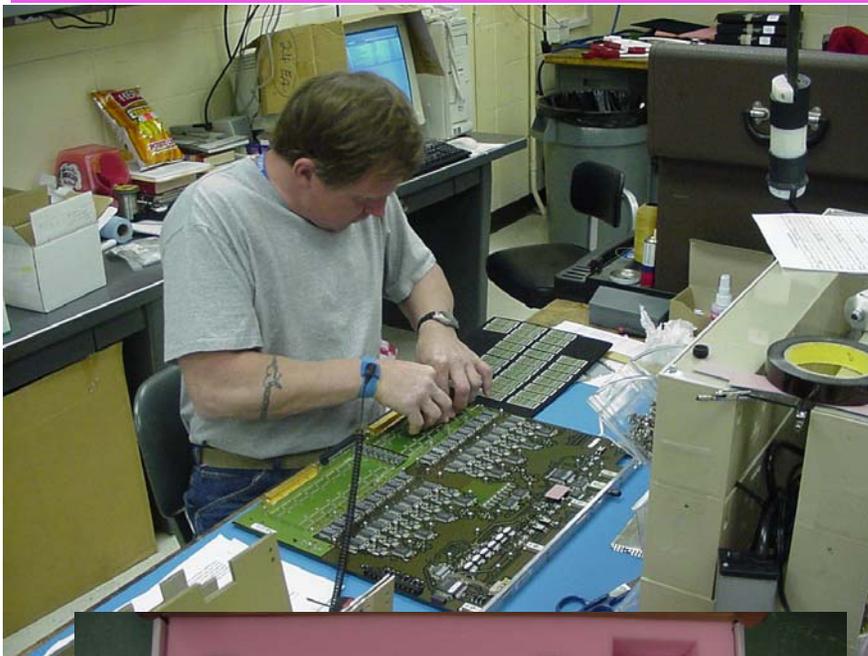


Liquid Argon - Status

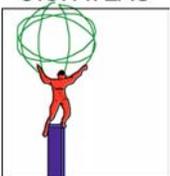
- **Two items are on the critical path for ATLAS**
 - ◆ **The DC-DC Power Supplies – Contract has been in place for about a year and is on schedule**
 - ▲ **However, first articles did not perform perfectly**
 - ▲ **Problem thought to be understood as being due to capacitors and the production is being adjusted for this**
 - ▲ **First 17 of 68 final supplies are due this month**
 - ◆ **Front End Boards (FEB)–**
 - ▲ **BNL completes final assembly and test (see photos and visit on tour today)**
 - ▲ **Problem with OTx (optical driver) is the latest in a series of technical challenges**



LAr FEB



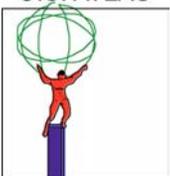
See on tour



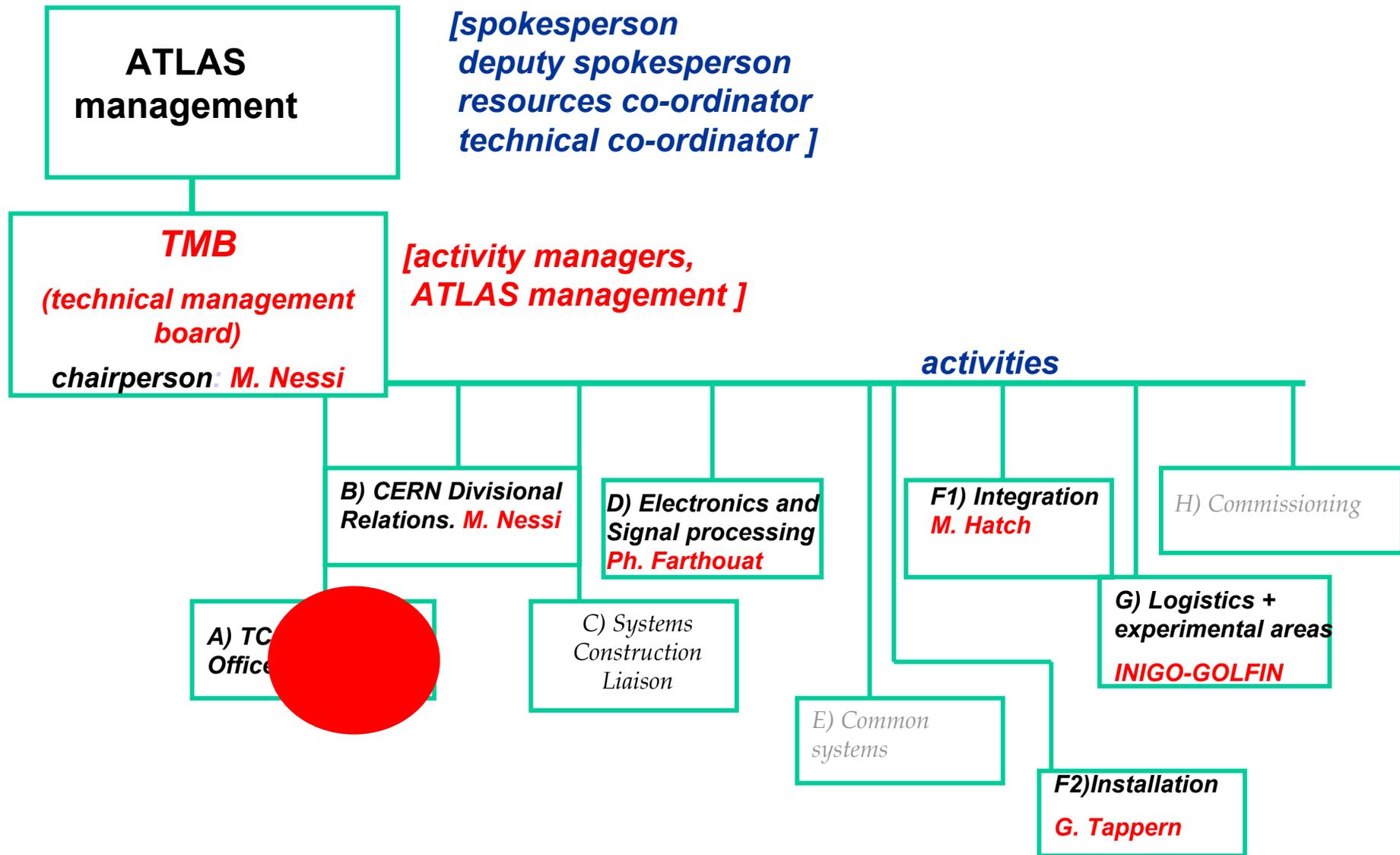
Cathode Strip Chambers (Muons)

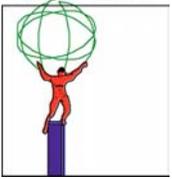
- Mechanical chambers were complete in 2004
- Now electronics is finishing production
 - ◆ Need to install and test the electronics
 - ◆ Transport the chambers to CERN for installation on the Big Wheel





TC organization





US Involvement

US Physicists Involved in TC:

- D. Lissauer** - TC Activity A, Placement Strategy (BNL)
- M. Shupe** - Radiation/Activation Studies (Arizona)
- J. Bensinger** - Forward Muon Integration (Brandeis)
- B. Stanek** - Movements (ANL)
- M. Sharp** - Installation Data Base (Nevis@ CERN)

TC Support @ CERN:

- K. Pommès** Project Management – Eng.
- T. Klioutchnikova** Senior Designer – Conf. Control
- A. Foussard** Installation Feet/Magnet.

BNL:

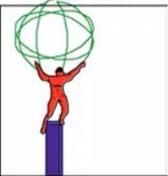
- S. Norton** Senior Designer – Conf. Control
- A. Gordeev** Engineer – Access
- J. Farrell** Designer

ANL:

- J. Grudzinski** Movements/FEA Calc.

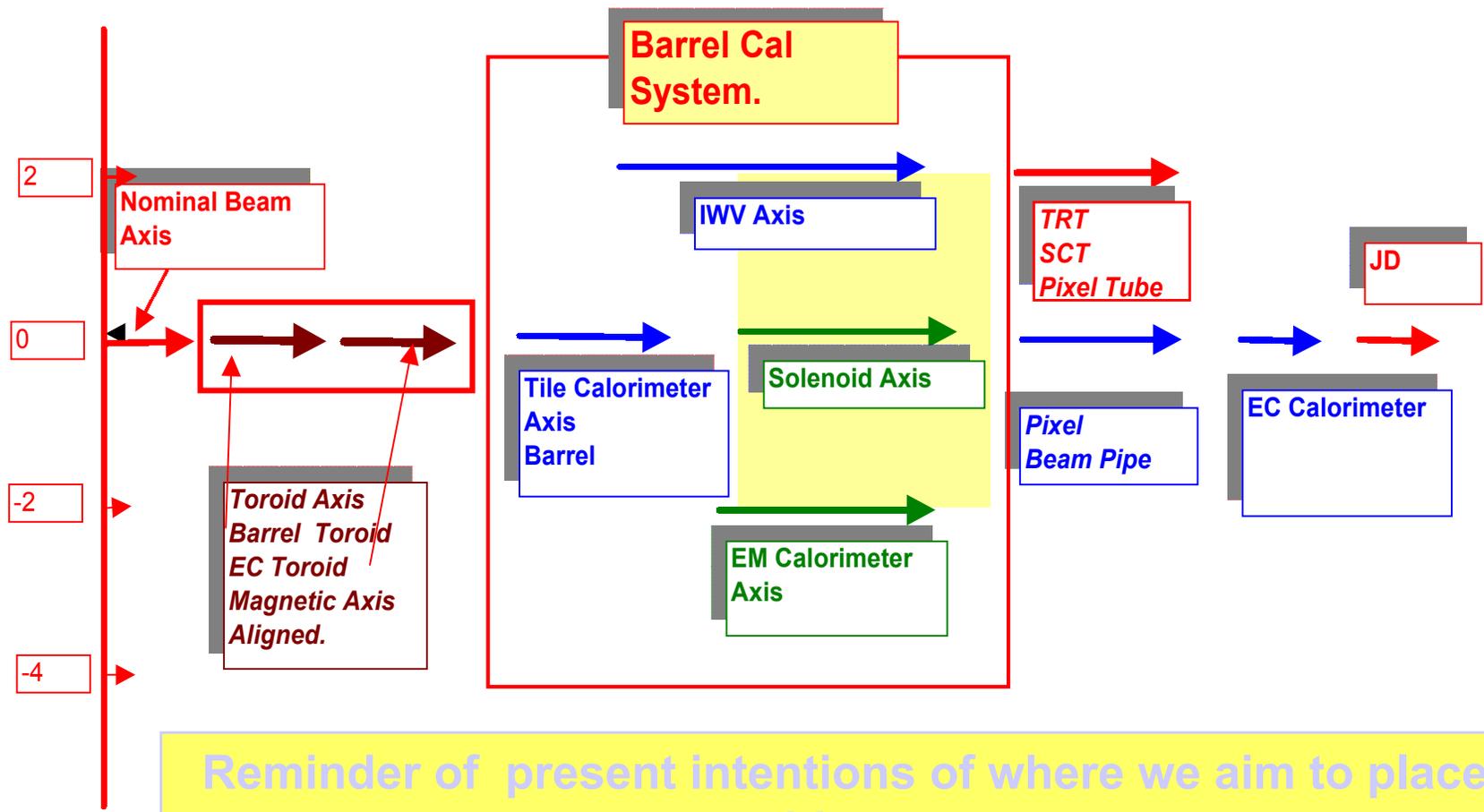
LBL:

- E. Anderson**



Example of BNL Activity in TC from David Lissauer's talk at the TMB on April 21, 2005

mm displacement relative to nominal axis

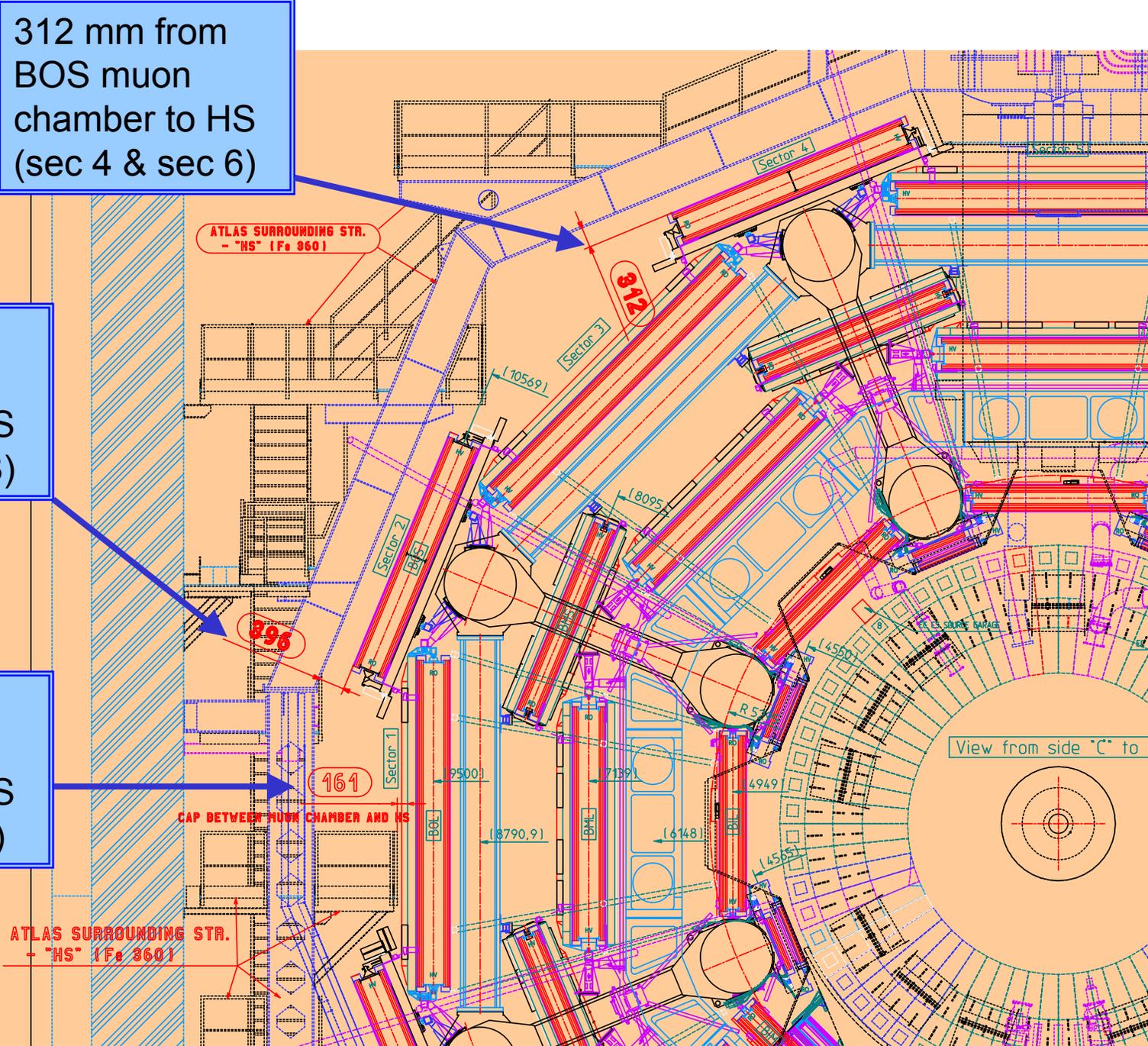


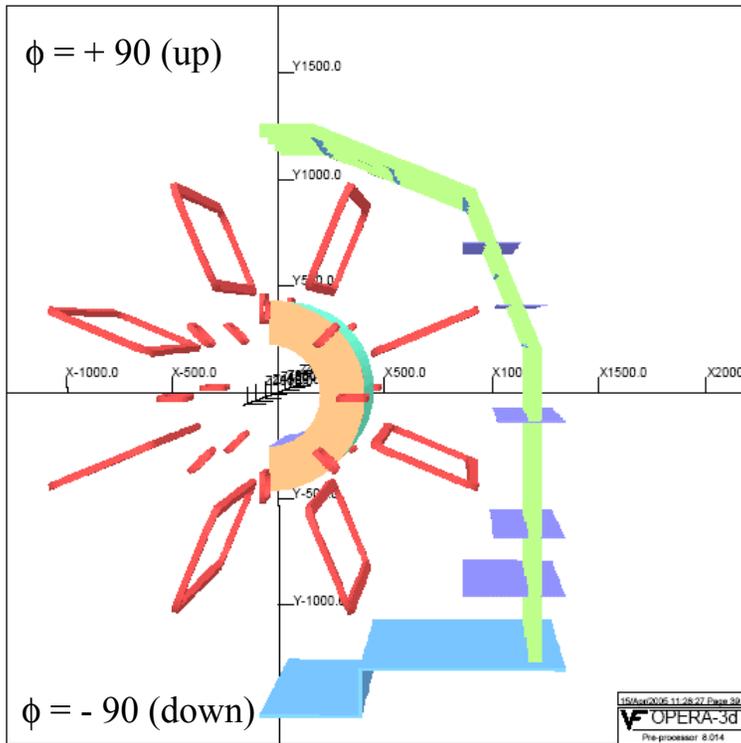
Reminder of present intentions of where we aim to place objects.

312 mm from BOS muon chamber to HS (sec 4 & sec 6)

396 mm from BOS muon chamber to HS (sec 2 & sec 8)

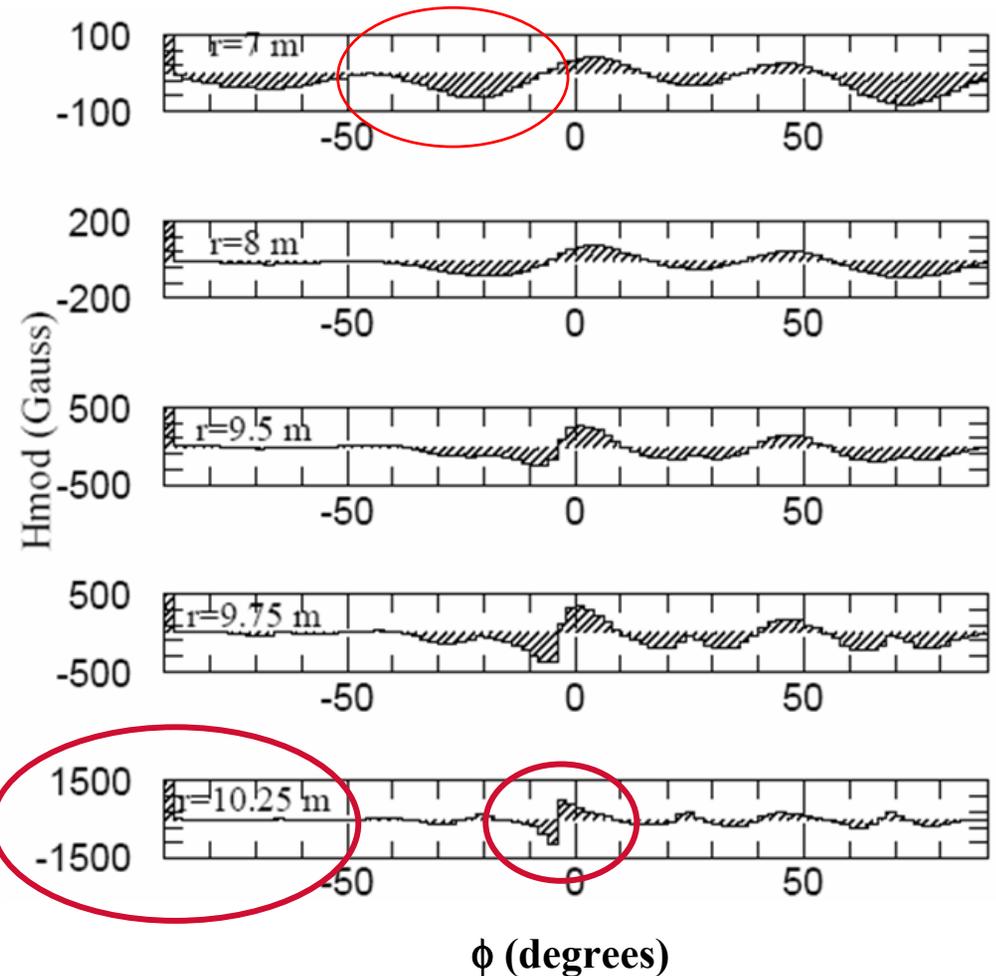
161 mm from BOL muon chamber to HS (sec 1 & sec9)





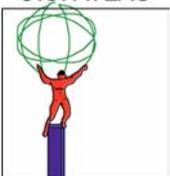
I. Stumer (BNL) [updated 19 Apr 05]

$$\Delta|H| = (\text{coils+HS}) - (\text{coils only}) @ z=0$$



Conclusions (so far..)

- the HS structure effects range from 50 to 1000 Gauss when radius is increased from 7 to 10 meters.
- At least part of the discrepancy wrt early estimates is associated with better modelling of platforms & poles
- **But several issues in this simulation remain to be clarified/understood**
- **➔ PRELIMINARY !**

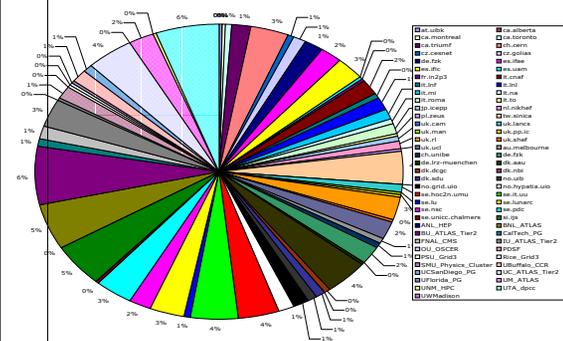
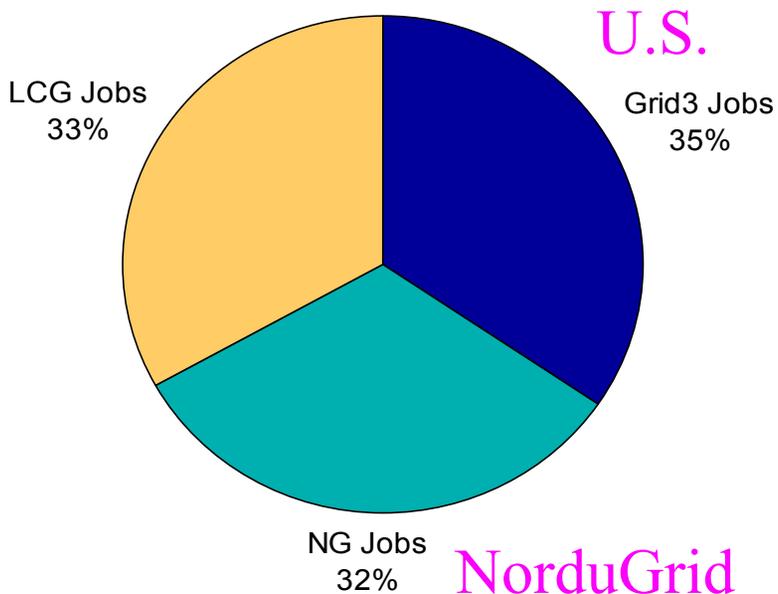


US ATLAS Tier 1 Data Challenge II Participation

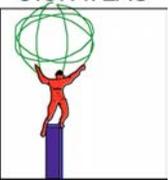
- US ATLAS supplied more than the anticipated 20% of the DC 2 compute capacity via Grid3

- US ATLAS Tier 1 at BNL supplied 5% of total DC 2 capacity, 3rd highest individual institution
- Other US ATLAS sites were also among the highest

DC2 Jobs (till Jan 22, 2005)



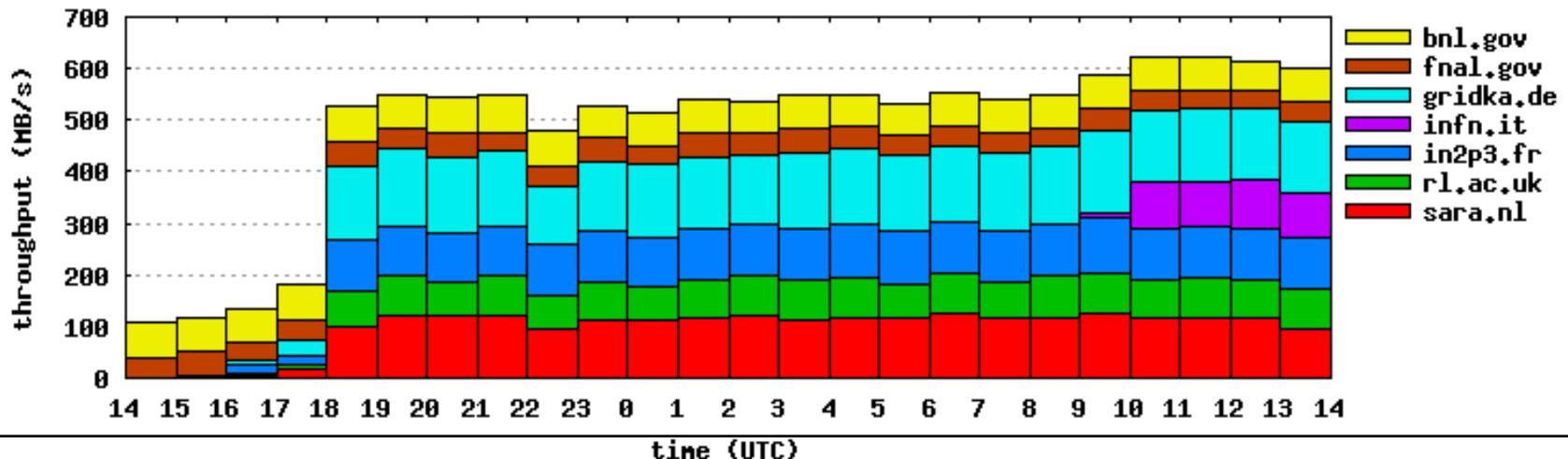
BNL



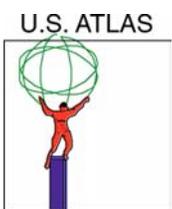
US ATLAS Tier 1 Service Challenge Participation

- BNL's current connection is 2.5 Gb/s via ESNET
- Based on the January 2005 ATLAS Computing Model and U.S. extensions of it, BNL needs to have 20 Gb/s by 2008
- LCG (LHC Grid Computing Project) network service challenges specify 10 Gb/s this year at all Tier 1 sites

Overall hourly averaged throughput during the last 24 hours

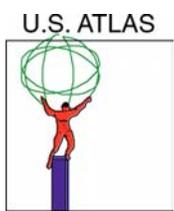


BNL is participating like other world centers.

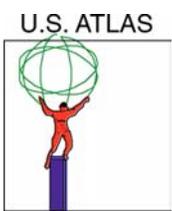


Conclusions

- **BNL is playing a leading role in U.S. ATLAS and ATLAS overall:**
 - ◆ **Physics**
 - ◆ **Management**
 - ◆ **Detector Construction → Installation → Commissioning → M&O**
 - ◆ **Computing**
 - ◆ **Upgrade R&D**
- **The erosion of the “Core Research” Program support prevents us from reaching our full potential**
 - ◆ **BNL has little flexibility**
- **DOE MUST plan (after consultation with the U.S. ATLAS Collaboration) to increase funding to BNL for a U.S. ATLAS Physics Analysis Center at BNL**



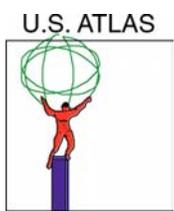
Backup Slides



Lissauer's Conclusions

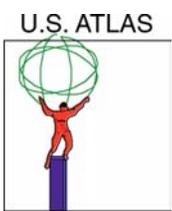
- Floor movements is at the upper range of our expectations.
- Need to follow up and measure the time dependency.
- Understand better the effect on the machine.
- Toroid Position is now fixed by the first two coils.
- Next measurement in August '05.
- Rail decision and final height fixation after that.
- Next major decision will be rail and Barrel System in Sept. 05.

Flexibility in installation approaching Zero fast!!!



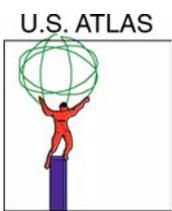
LCG Positions

- **Bruce Gibbard**
 - ◆ **US Representative to LCG Phase 2 Planning**
 - ◆ **US Representative to LCG Technical Design Report Editorial Board**
 - ◆ **Deputy US representative to Grid Deployment Board**
 - ◆ **US ATLAS Representative to T0/T1 Network Group**
- **Razvan Popescu**
 - ◆ **US ATLAS Representative to LCG Base Services Group**
- **Tom Throwe**
 - ◆ **US ATLAS Representative to LCG Security Project**



U.S. ATLAS Funded Tier 1 Staff (1)

- **Maurice Askinazi**
 - ◆ Team Lead for centralized disk & facility infrastructure services
- **Gabriele Carcassi**
 - ◆ Software developer – VO and privilege projected designer/developer/integrator
- $\frac{1}{2}$ **Bruce Gibbard**
 - ◆ US ATLAS Facilities Manager
- **Christopher Holloway**
 - ◆ Linux farms specialist – OS and parallel configuration & system management system
- **Zhenping Liu**
 - ◆ Web services specialist – dCache/SRM deployment and testing
- **Razvan Popescu**
 - ◆ Deputy US ATLAS Facilities Manager



U.S. ATLAS Funded Tier 1 Staff (2)

- **Jason Smith**
 - ◆ **OSG / ATLAS Grid administration specialist – site development, deployment, optimization & operation**
- **Alex Withers**
 - ◆ **Resource management expertise – LSF, Condor, customized HPSS interface**
- **Tomasz Wlodek**
 - ◆ **Facilities experienced software developer – customized resource manager, DC Operations**
- **Xin Zhao**
 - ◆ **OSG / ATLAS Grid configuration specialist – remote site deployment & verification, DC Operations**
- **Four Additional Openings**
 - ◆ **Sys admin**
 - ◆ **DB admin**
 - ◆ **Software devel**
 - ◆ **Sys admin/Web**