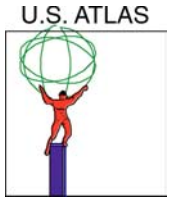


BNL's Role in ATLAS

Howard Gordon

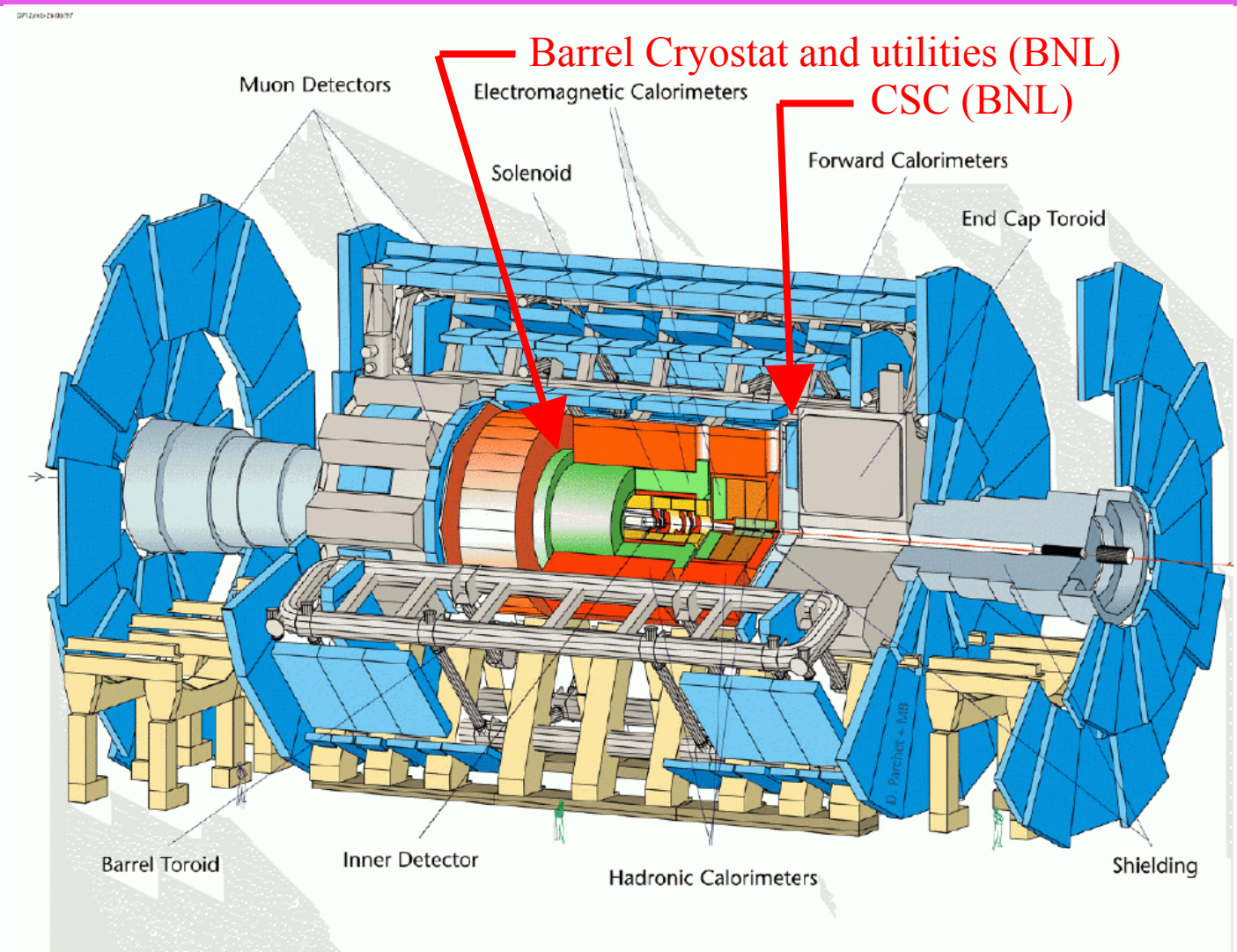
DOE Annual HEP Review

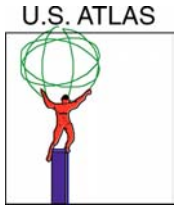
Brookhaven National Lab

May 22, 2003

U.S. ATLAS

The ATLAS Experiment





Plan for the ATLAS Talks

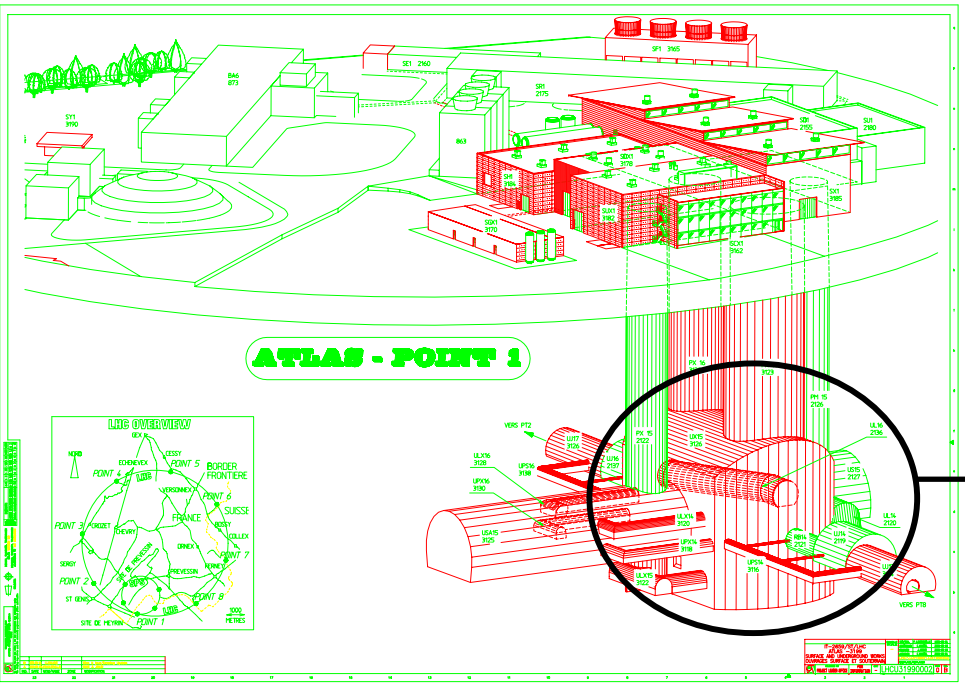
- BNL's Role in ATLAS H. Gordon (now on ATLAS EB)
  - Physics
  - BNL Role US ATLAS Management
  - Plans for Analysis Center
- From Construction to the Installation/Commissioning H. Ma

  Work in close collaboration with the Instrumentation Division
  - Liquid argon calorimeter
    - Cryostat and Cryogenics
    - LAr Readout
  - Cathode strip chambers for the Muon system
  - ATLAS Technical Coordination
  - ATLAS upgrade – tracking/calorimeter
- Software and computing/Transition to Physics S. Rajagopalan
  - Software
    - Core, Simulation/Reconstruction
  - Analysis & Physics
  - Facility Support

UX15 Cavern

Civil Engineering works in the final stage

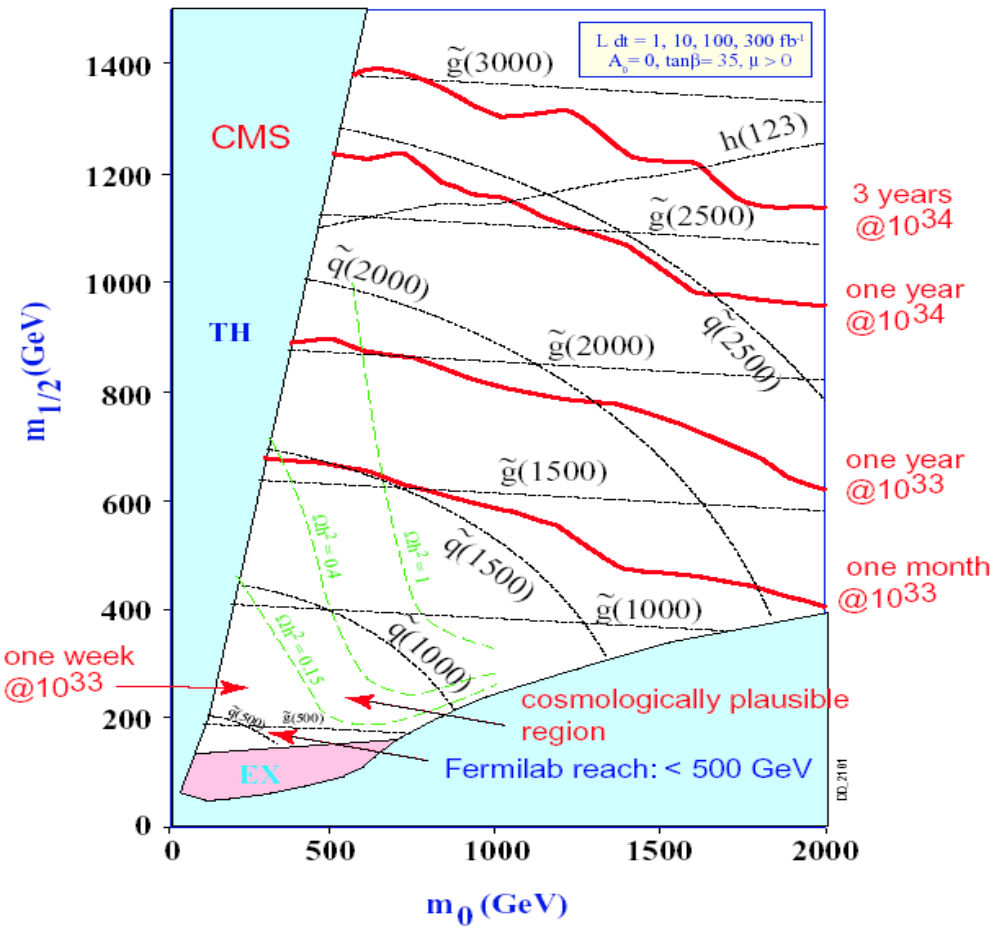
Installation of TX1S shielding fixed tube done April 3



The ATLAS Installation work and all its logistics are coordinated by an Experimental Area Management (EAM), operational since a few months

U.S. ATLAS

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(SUSY) is less than a few TeV.

ATLAS Physics Topics Led by Frank Paige

SUSY Reconstruction with Athena

SUSY gives complex signatures with jets, e's, μ's, τ's, b jets, $\not{E}_T$.

All SUSY particles decay to invisible $\tilde{\chi}_1^0$'s $\Rightarrow$ no mass peaks. Determine mass combinations by identifying decay chains and fitting endpoints.

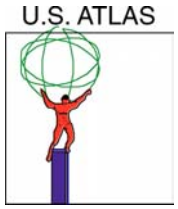
Have now simulated 100k events in ATLAS with full GEANT for typical SUSY point: mSUGRA with

$$m_0 = 100\,\text{GeV},\ m_{1/2} = 300\,\text{GeV},\ A_0 = -300\,\text{GeV},\ \tan\beta = 6,\ \text{sgn}\,\mu = +$$

Reconstruction with Athena. Gives both $\tilde{\chi}_2^0 \to \tilde{\ell}_R^{\pm}\ell^{\mp}$ and τ signatures.

Have been developing Monte Carlo truth, jet calibration, τ reconstruction, and testing Athena in complex events.

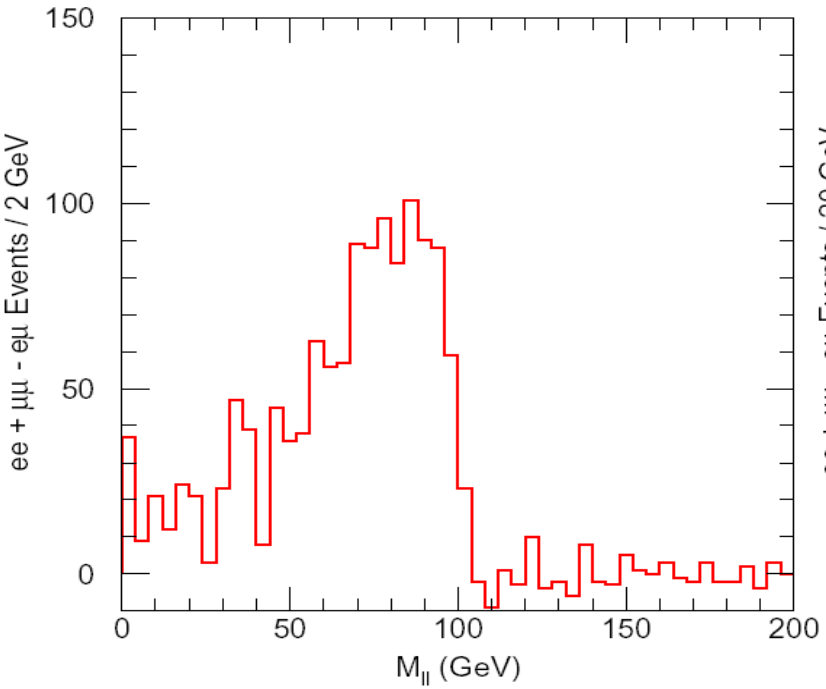
Should have results for Athens Physics Workshop.

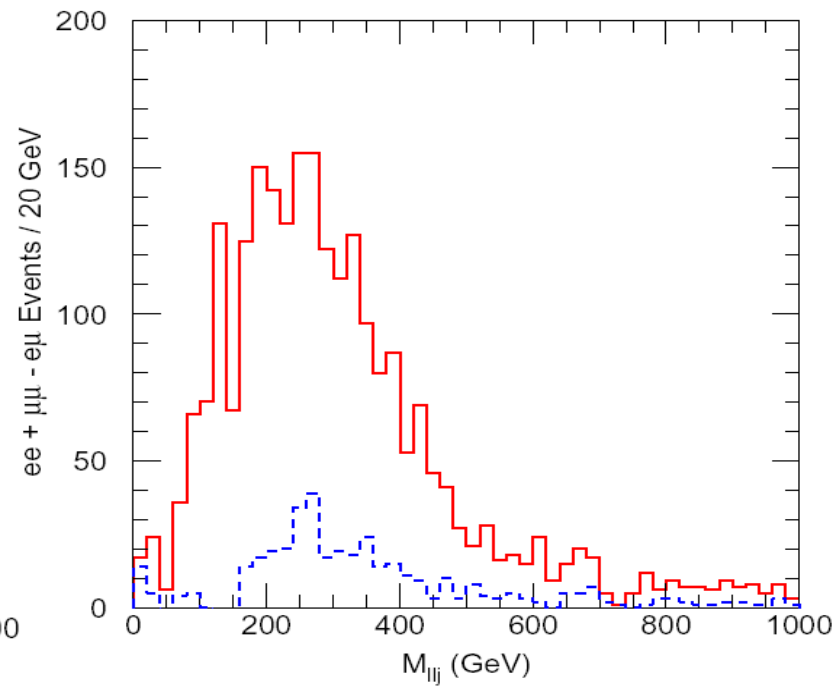


SUSY Endpoints- More details in Srini's talk

SUSY Endpoints

Repeat *Physics TDR* analysis of $\tilde{q}_L \to \tilde{\chi}_2^0 q \to \tilde{\ell}_R^{\pm} \ell^{\mp} q \to \tilde{\chi}_1^0 \ell^+ \ell^- q$ decay chain. Expect $\ell^+\ell^-$ and $\ell^+\ell^- q$ endpoints at 100.1 GeV and 498.9 GeV:

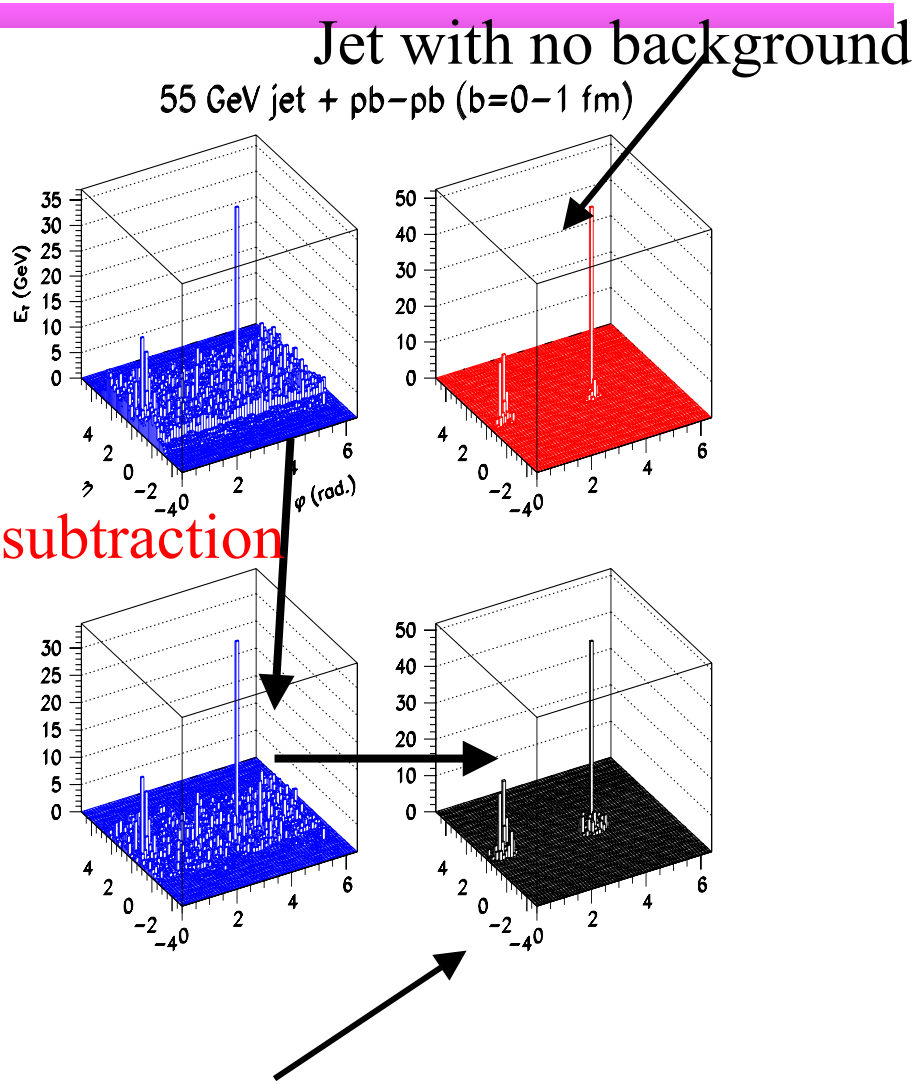




Too bad this is not 2 fb^{-1} of real data!

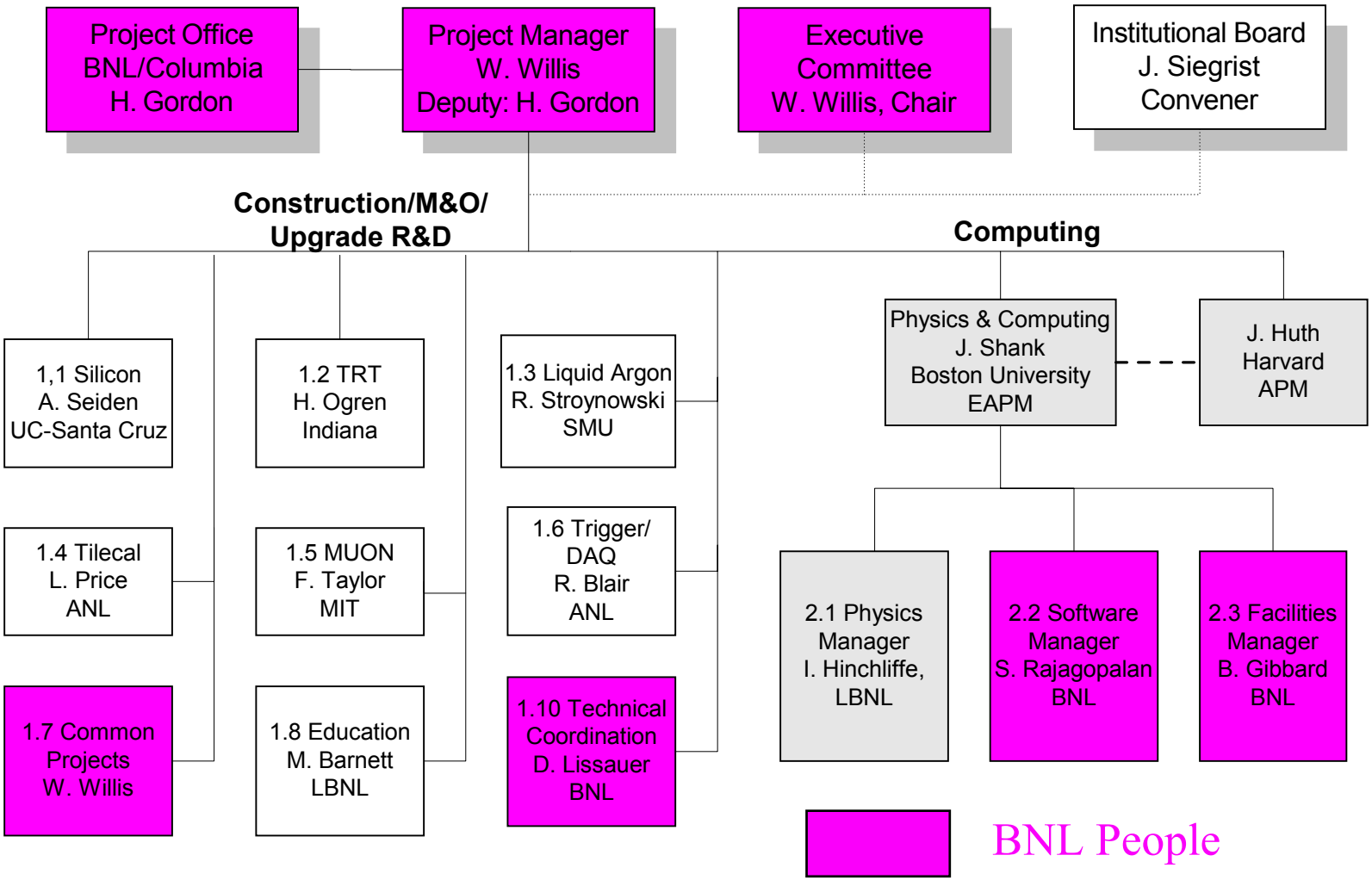
Physics Analyses led by Ketevi Assamagan

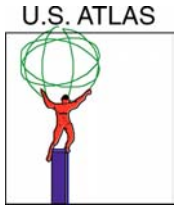
- ATLAS Heavy Ion Program: jet reconstruction in heavy ion background
- Search for Large Extra Dimensions in the extended Higgs sector: Eur Phys J direct C4:9 (2002)
- ATLAS potential for the discovery of the Charged Higgs: Phys Rev D65 076006 (2002)
- Search for lepton flavor violation in the extended Higgs: Phys Rev D67 035001 (2003)



U.S. ATLAS Organization

U.S. ATLAS Organization

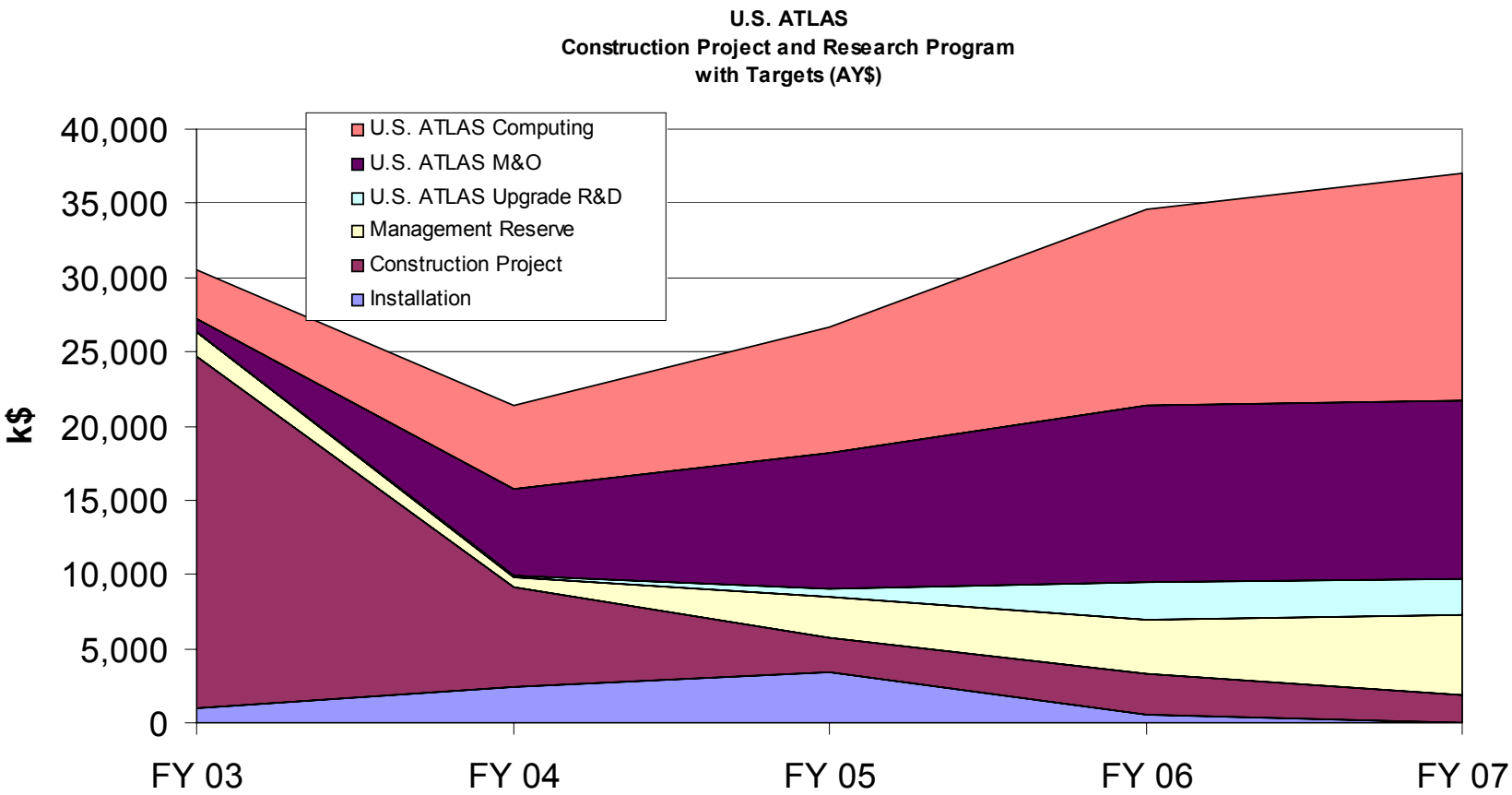




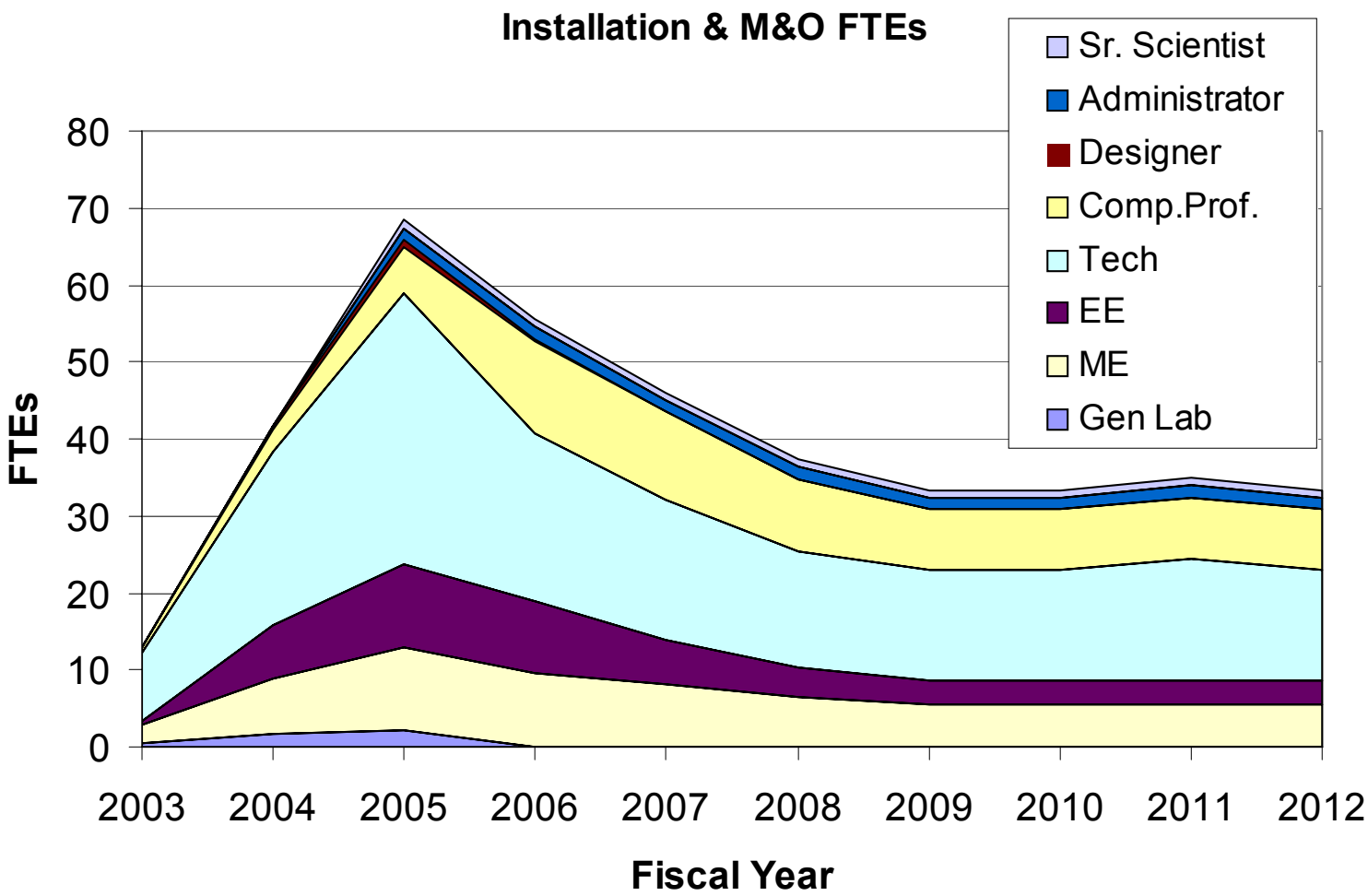
U.S. ATLAS Project and Research Program Management

- BNL is the Host Lab for the 33 U.S. institutions in ATLAS
- We have (almost) constant reviews
- We are planning for 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 conducted a survey from U.S. ATLAS Institutions to give insight into the needs from the Base Program

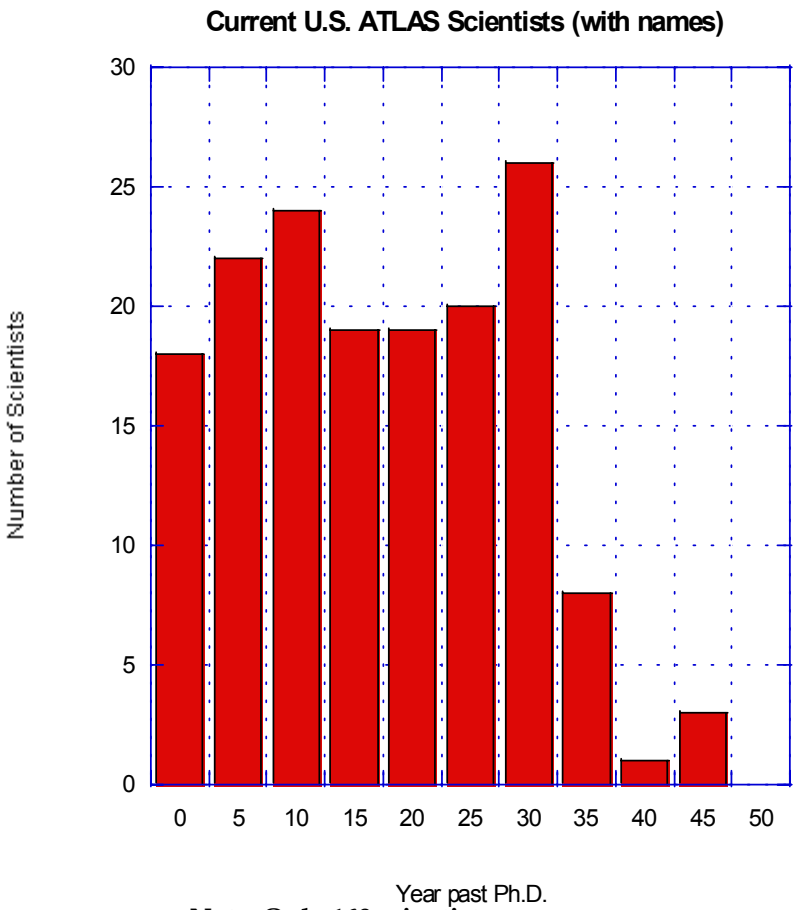
Construction Project + Research Program Funding for U.S. ATLAS has a Notch in FY04



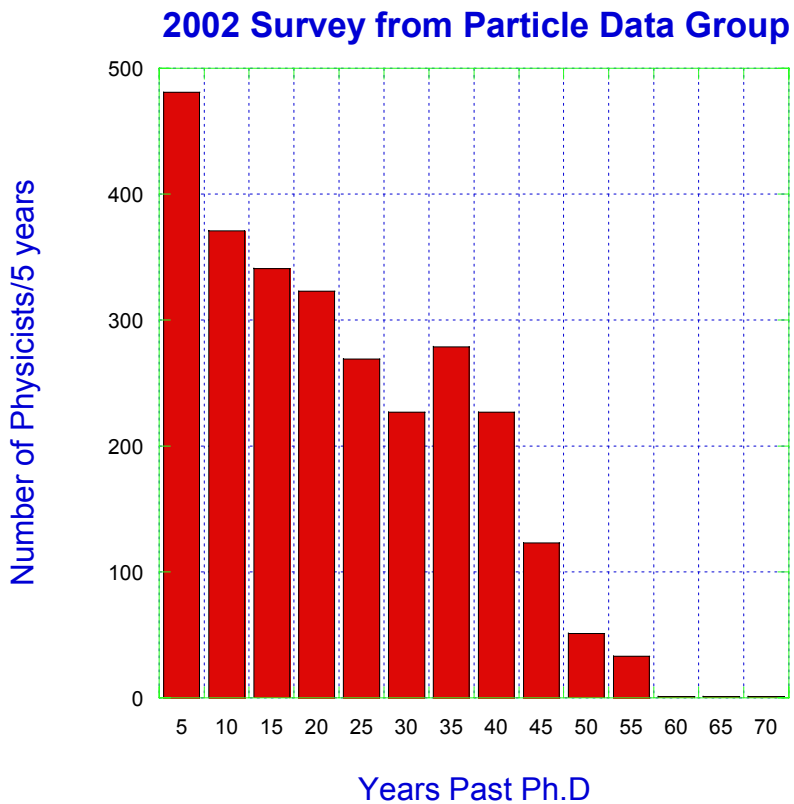
FTEs for the Research Program and Installation



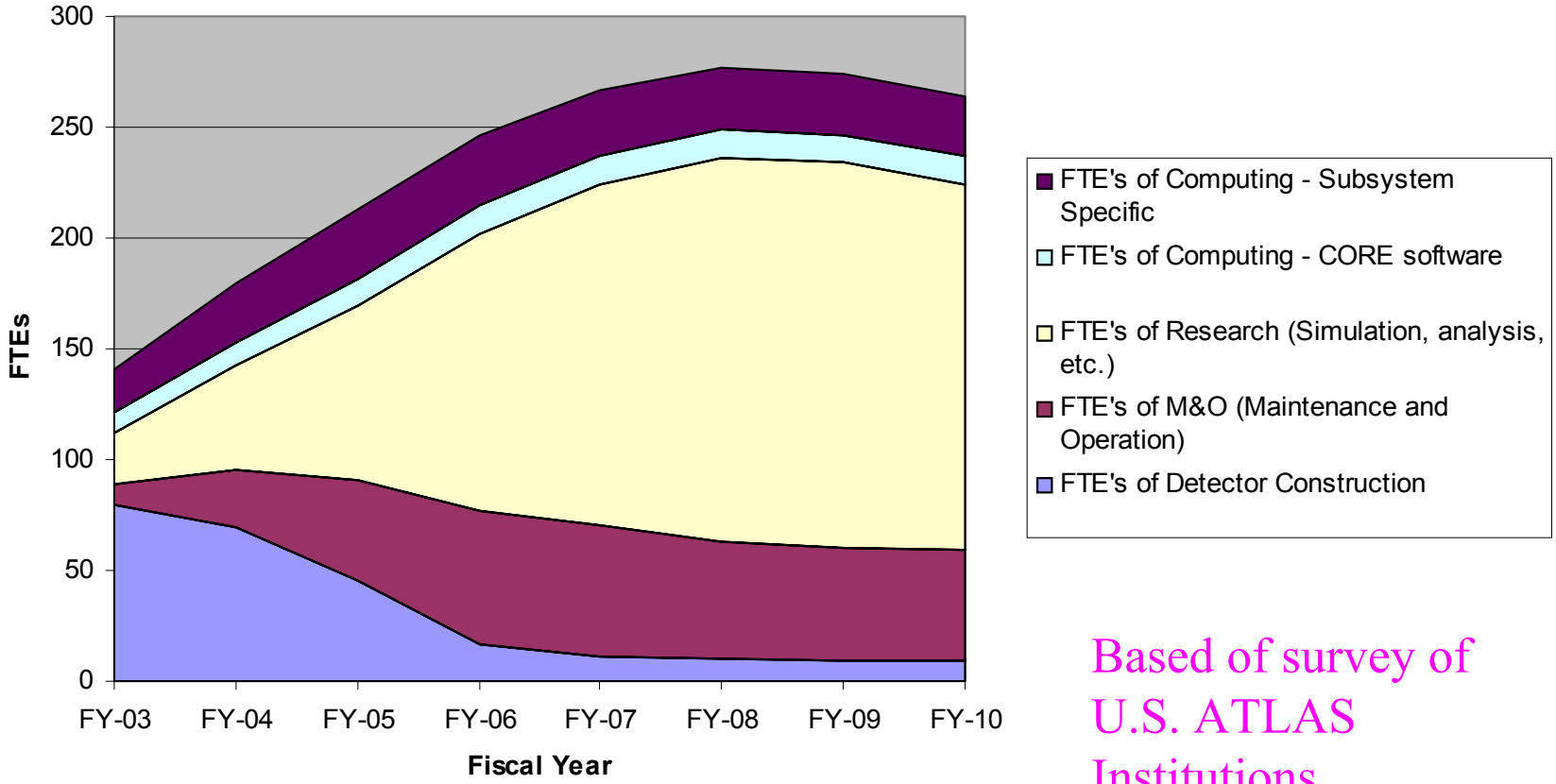
Age Profile for U.S. ATLAS needs to have a younger component



Note: Only 160 scientists responded to our survey.



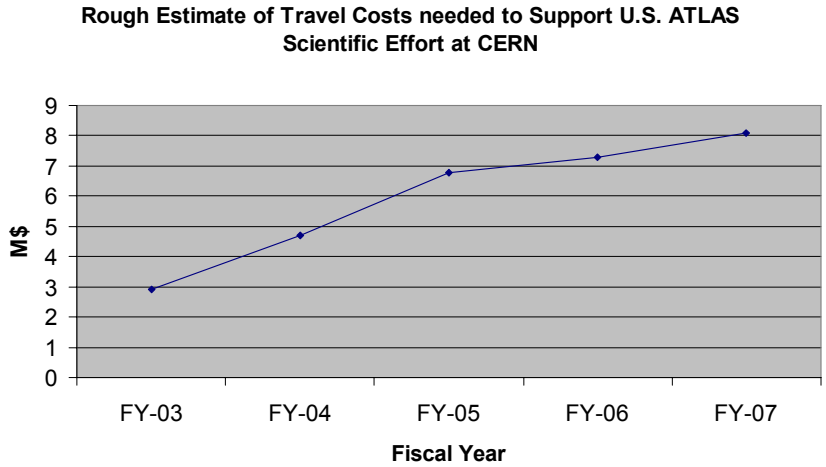
Projected Scientific Effort by U.S. ATLAS

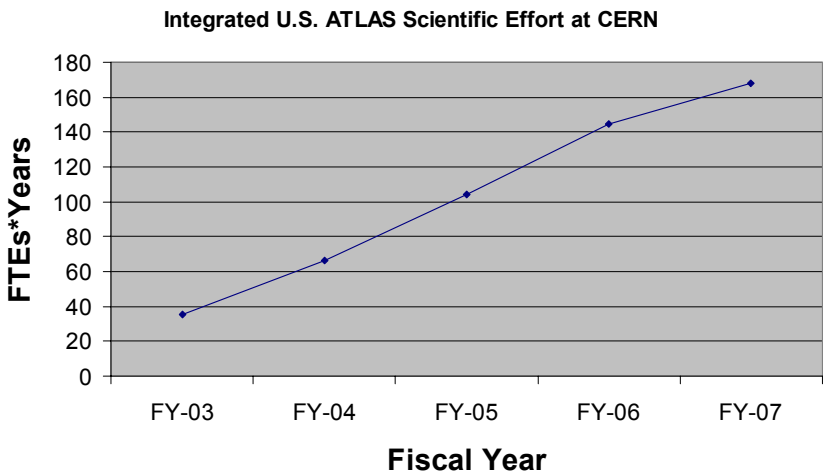


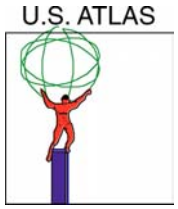
Based of survey of U.S. ATLAS Institutions

Base Program Support is Needed for U.S. Scientists working at CERN

- Data from our U.S. ATLAS Survey shows needs increasing (U.S. CMS has similar needs so just multiply by 2)
  - Raw data is number of trips and average length of time of each trip.
- However, DOE funding for proton research is eroding: e.g. less than flat-flat from FY03->FY04 (see J. O'Fallon's talk at HEPAP, March 7, 2003)
  - ANL, BNL, LBNL cut even more
- This should come from redirection but the travel cost/trip is more expensive than travel in the U.S.
- Another issue is the funding of faculty who would like to spend a year at CERN. There is no way to pay for the traditional ½ salary as when visiting Fermilab for example. Some such visits will be critical and CERN will not support them.







U.S. ATLAS Physics Analysis Center

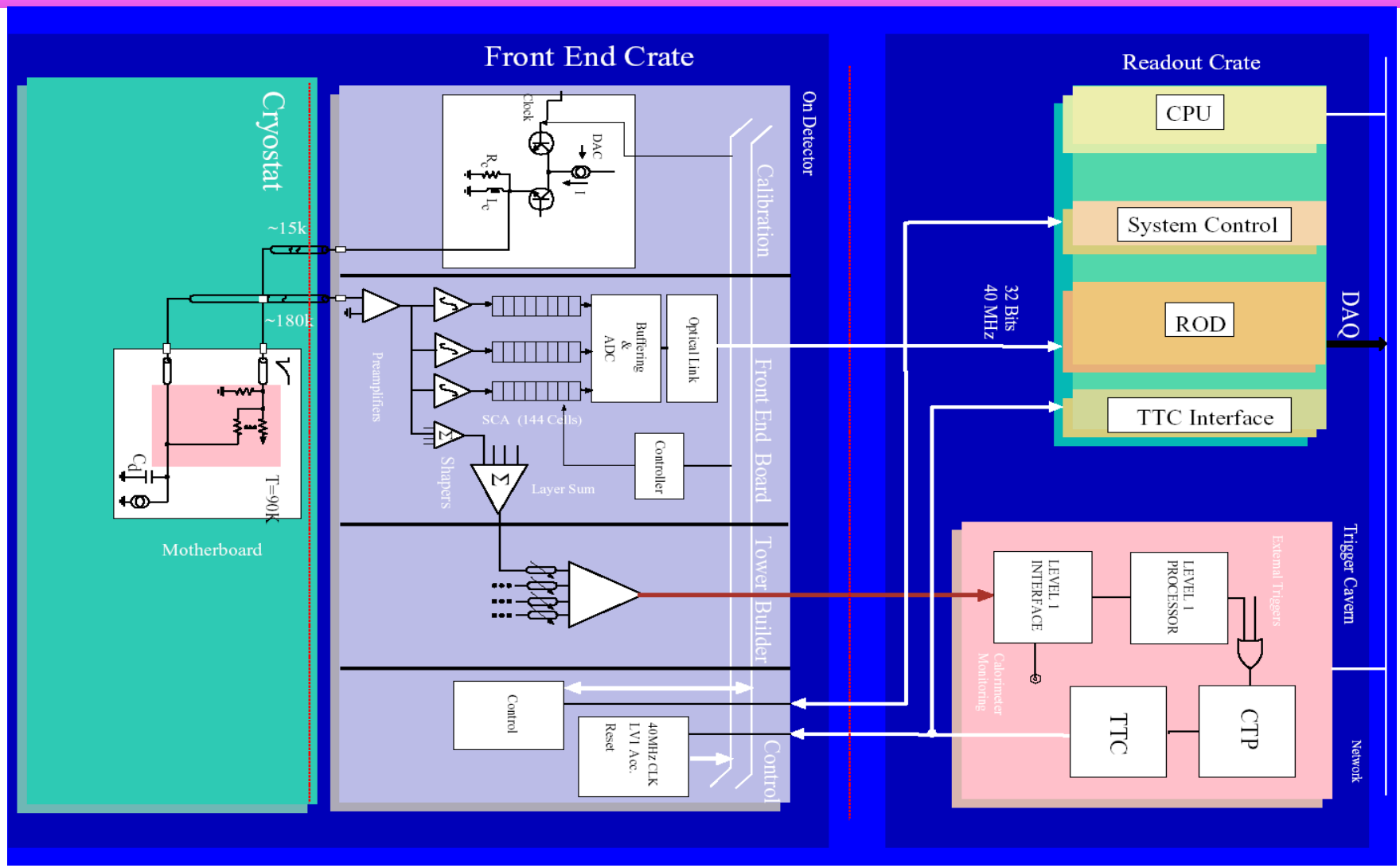
- **Motivation:**
  - Position the U.S. to insure active participation in ATLAS physics analysis
  - Builds on existing Tier 1 ATLAS Computing Center, CORE Software leadership at BNL, and theorists who already are working closely with experimentalists.
  - This BNL Center will become a place where U.S. physicists come with their students and post-docs.
- **Scope and Timing:**
  - Hire at least 1 key physicist/year starting in 2003 to add to excellent existing staff to cover all aspects of ATLAS physics analysis: tracking, calorimetry, muons, trigger, simulation, etc.
  - Expect the total staff including migration from D0 will reach ~25 by 2007
  - First hire in 2003 – We have some excellent candidates now ($?)
  - The plan is to have a few of the members in residence at CERN for 1-2 years on a rotating basis.
- **Cost:**
  - DOE needs to increment the declining BNL HEP base program. ~$200k/year FY03-> $1.5M in FY07

Liquid Argon - Status

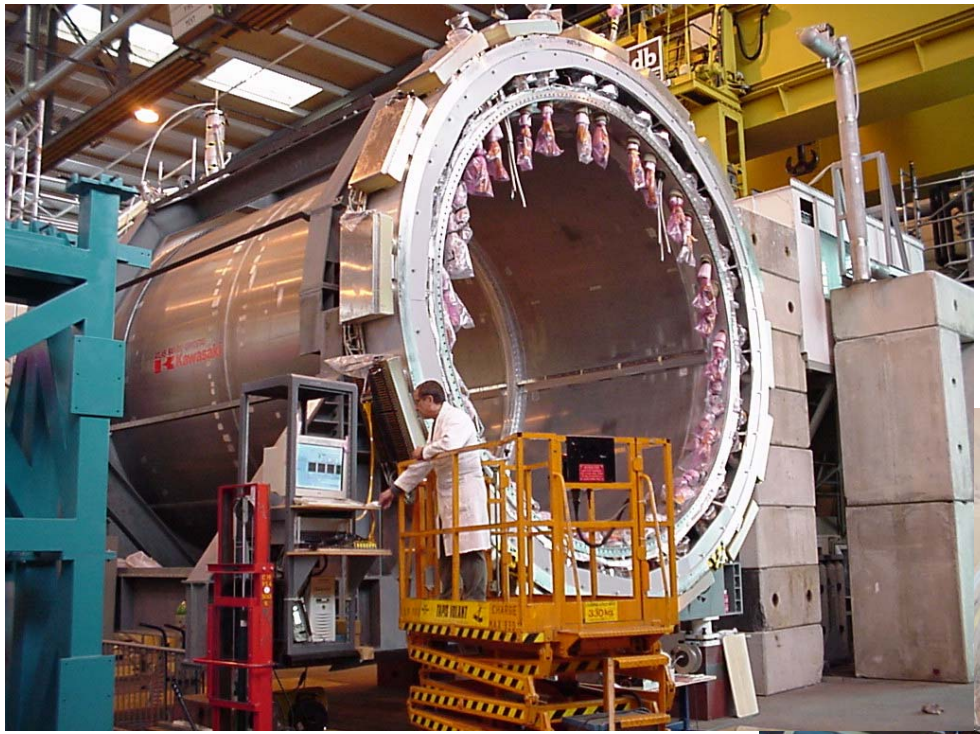
- 1.3.1 Barrel Cryostat – Jack Sondericker et al. Complete – support still needed
- 1.3.2 Signal Feedthroughs – Bob Hackenburg – Complete – support still needed
- 1.3.3 Cryogenics –Jack Sondericker et al. Production almost complete
- 1.3.4 Kapton Electrodes and Motherboards – Srini Rajagopalan – complete
- 1.3.5 Preamps – Hong Ma – Complete
- 1.3.6 System Crate –
  - Crates and Pedestals complete
  - Radiation Tolerant Power supplies - Jim Kierstead – prototypes coming
  - Cooling Plates – Helio Takai yet to go into production –
  - Integration part of System Crate Test at BNL: Francesco Lanni, Huchen Chen, Don Makowiecki, George Redlinger, Veljko Radeka, Sergio Rescia, Helio Takai
- Production Database – Bob Hackenburg

U.S. ATLAS

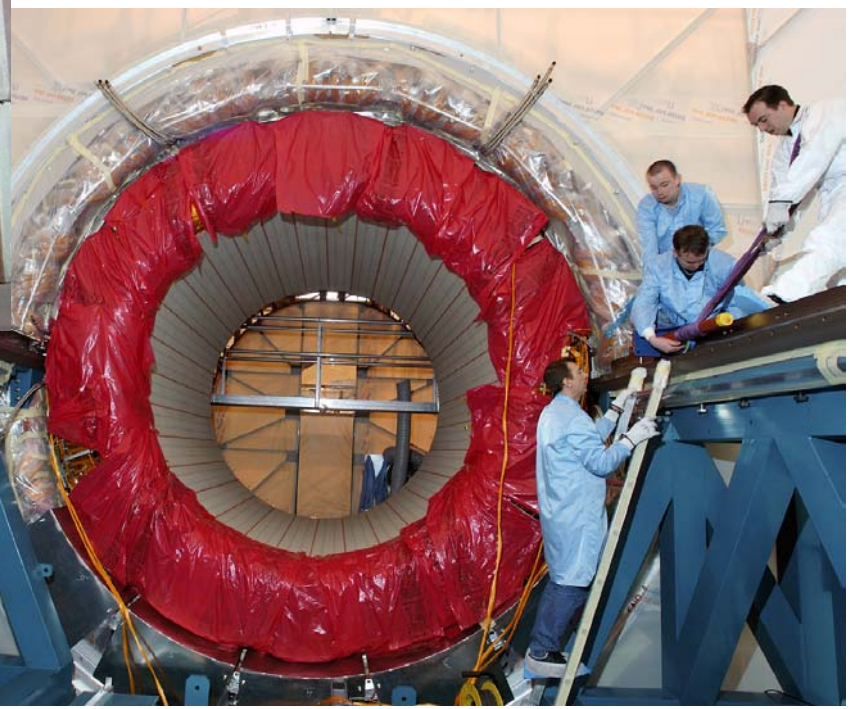
Liquid Argon Schematic



U.S. Supplied: Liquid Argon Cryostat with Signal Feedthroughs, Pedestals, Base Planes

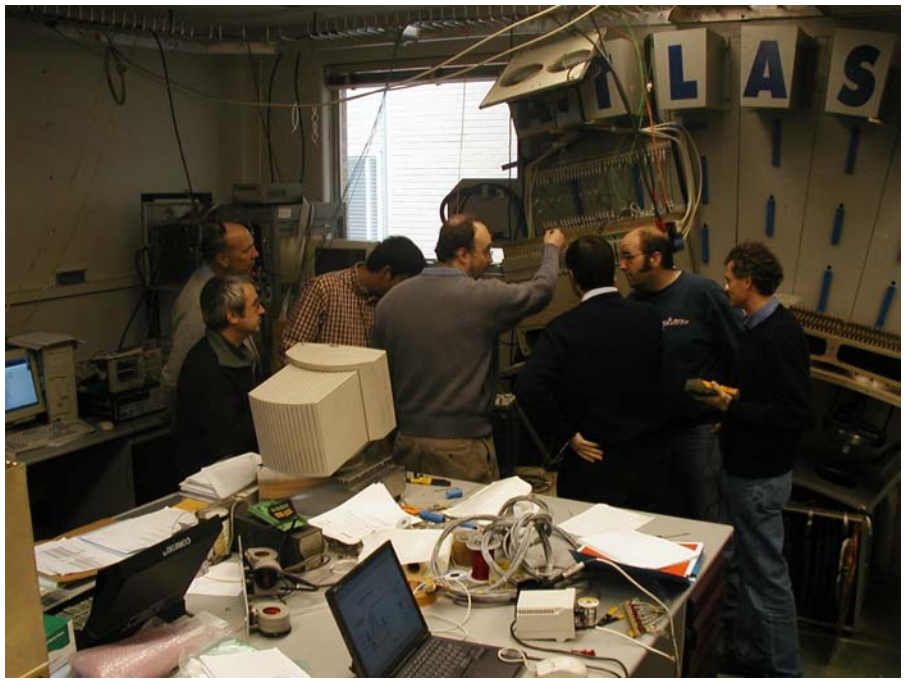


TDR Measurements at the LAr Barrel Signal Feedthroughs



LAr EM half barrel after insertion into the cryostat

Liquid Argon System Crate Test



- We will visit on 1 PM tour
- Test integrates all the electronics in ATLAS LAr system for the first time with actual components.
- Precursor of the testing of the Front End Boards
- This test brings lots of our international collaborators

LAPP, Annecy: N. Dumont, G. Ionescu, I. Wingerter-Seez,

BNL: P. Bijoneau, H. Chen, A. Hoffmann, J. Kierstead, D. Lissauer, F. Lanni, D. Makowiecki, V. Radeka, G. Redlinger, S. Rescia, H. Takai

SMU, Dallas: A. Tiankuan Liu, J. Ye, P. Zarzhitsky

CERN, Geneva: L. Hervas

INFN, Milan: M. Citterio, M. del Mastro, M. Fanti, T. Frattini

Nevis Lab: I. Katsanos, S. Negroni, J. Parsons, S. Simion

LAL, Orsay: C. de la Taille, N. Seguin-Moreau, L. Serin

LPHNE, Paris VI: M. Escalier, B. Laforge, O. Ledortz

Pittsburgh Univ.: B. Cleland, J. McDonald

SUNY Stony Brook: R. Engelmann, H. Themann

DAPNIA, Saclay: X. de la Broise, A. Le Coguie

U.S. ATLAS

CSC Facility

U.S. ATLAS

Epoxy Fixture During Cure

U.S. ATLAS

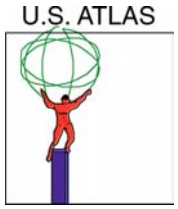
X-X Panel Wire Winding

U.S. ATLAS

X-X Panel Operations

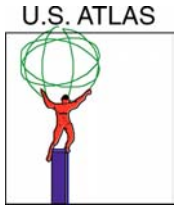
U.S. ATLAS

Electronic Flatness Testing



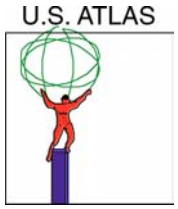
Planned M&O Support at BNL

- Funding FY04 $986k FY05 $1,441k
- FTEs FY04 5.2 FY05 8.0
- Tasks include
  - Setup of CSC Staging and Test Stations
  - Pre-operations and Commissioning of 32 CSC chambers
  - Documentation update for Liquid Argon Equipment
  - Cryogenic System Commissioning, Test and Maintenance



Planned M&O Support at BNL(2)

- Integration and system test of electronics crates
  - Includes special VME boards for production electronics not yet available
- Commissioning of FEB
- Operations software support for the Crate
- Support of test beam operations
  - Includes modified electronics and controls for test beam configuration differences



ATLAS Technical Coordination
A U.S. View

- *Highlights from TC Activities in '02.*
  - *Infrastructure – Experimental Hall*
  - *Progress on Common Projects*
  - *ATLAS Installation*

- *US Involvement in TC*
  - *TC Project Office*
  - *Configuration Control – Envelopes*
  - *Access*
  - *Movements*
  - *Beam Pipe – Pixel Installation and LAr interface*
  - *Installation/INB Data –Base*
  - *Installation – placement specifications*

TC organization

ATLAS management

*[spokesperson
deputy spokesperson
resources co-ordinator
technical co-ordinator]*

TMB

(technical management board)

chairperson: M. Nessi

[activity managers, ATLAS management]

activities

- ***A) TC Project Office. D. Lissauer***
- ***B) CERN Divisional Relations. M. Nessi***
- *C) Systems Construction Liaison*
- ***D) Electronics and Signal processing Ph. Farthouat***
- *E) Common systems*
- ***F1) Integration M. Hatch***
- ***F2)Installation G. Tappern***
- ***G) Logistics + experimental areas INIGO-GOLFIN***
- *H) Commissioning*

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. Pommes	Project Management – Eng.
T. Klioutchnikova	Senior Designer – Conf. Control
A. Foussard	Installation Feet/Magnet.

BNL:

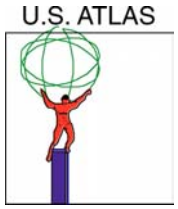
S. Norton	Senior Designer – Conf. Control
A. Gordeev	Engineer – Access
J. Farrell	Designer

ANL:

J. Grudzinski	Movements/FEA Calc.

LBL:

E. Anderson	Pixel/Beam Interface



Conclusions on TC

- **TC organization**
  - *TC "growth" has slowed down due to CERN financial problems.*
  - *Outside collaborators are putting TC at a higher priority but this might not be enough.*
- **US effort**
  - *Areas for US contributions have been identified.*
  - *Engineers have been identified both at CERN and in the US for the tasks.*
  - *Physicists involvement is increasing. (and should increase further)*
  - *U.S. effort is WELL integrated in to the general TC work.*
- ***M&O Funding***
  - *The M&O funding will allow us to follow up on our work*
  - *Commissioning of Access tools, movement system, configuration control, Installation Data base*
- ***The US is playing a critical role in TC and effort should increase to make sure that ATLAS is successful.***

U.S. ATLAS

Physics Potential of Super LHC

integrated luminosities :

- **LHC 100 fb^{-1}/year $L \leq 2 \times 10^{34}$**
- **SLHC 1000 fb^{-1}/year $L = 10^{35}$**

*** Detector Performance at SLHC needs to be similar to LHC.**

- **Higgs physics**
  - rare decay modes
  - Higgs self-couplings
  - Higgs couplings to fermions and bosons
- **Supersymmetry**
  - Heavy Higgs bosons of the MSSM
  - Mass reach up to 3 TeV
- **New Gauge Bosons**
- **Strongly-coupled vector boson system**
  - $W_L Z_L \rightarrow W_L Z_L$ $W_L W_L \rightarrow W_L W_L$, $Z_L Z_L$
- **Extra Dimensions**
- **Quark substructure**
- **Electroweak Physics**
  - production of multiple gauge bosons (n_V .ge. 3)
  - triple and quartic gauge boson couplings

Scientific Potential and Proposed Facility are labeled "Absolutely Central" by HEPAP for Orbach's 20 year Road Map

U.S. ATLAS

Inner Tracking

Intermediate Radius: ~20<r<~60 cm

•Aim for cell sizes 10 times smaller than conventional Si strip detectors.

benefit: momentum-resolution and pattern recognition

R&D:

- Lower cost/channel compared to present Si strip detectors
- Si macro-pixels of an area ~1mm^2 : pads or shorter strips ?
- Single sided two dimensional readout (new concepts)

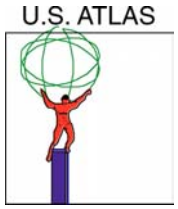
Large Radius: ~60<r

Large area Si detectors.
Could use present day 'radiation resistant' strip technology, or new single sided technology

R&D:

Similar to intermediate radius – less demanding except for *cost.*

Veljko Radeka *will discuss a possible direction tomorrow.*

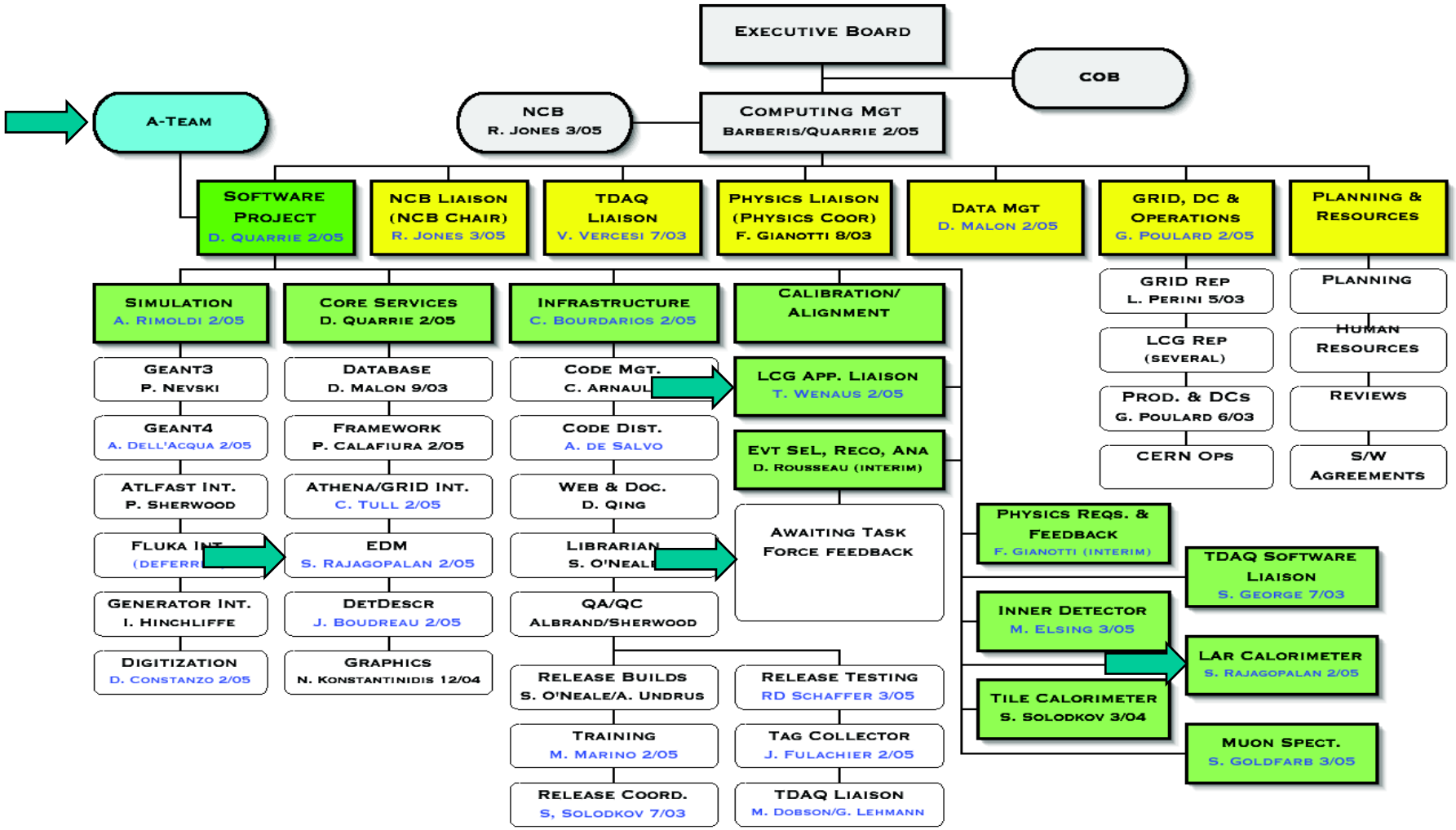


ATLAS Computing at BNL

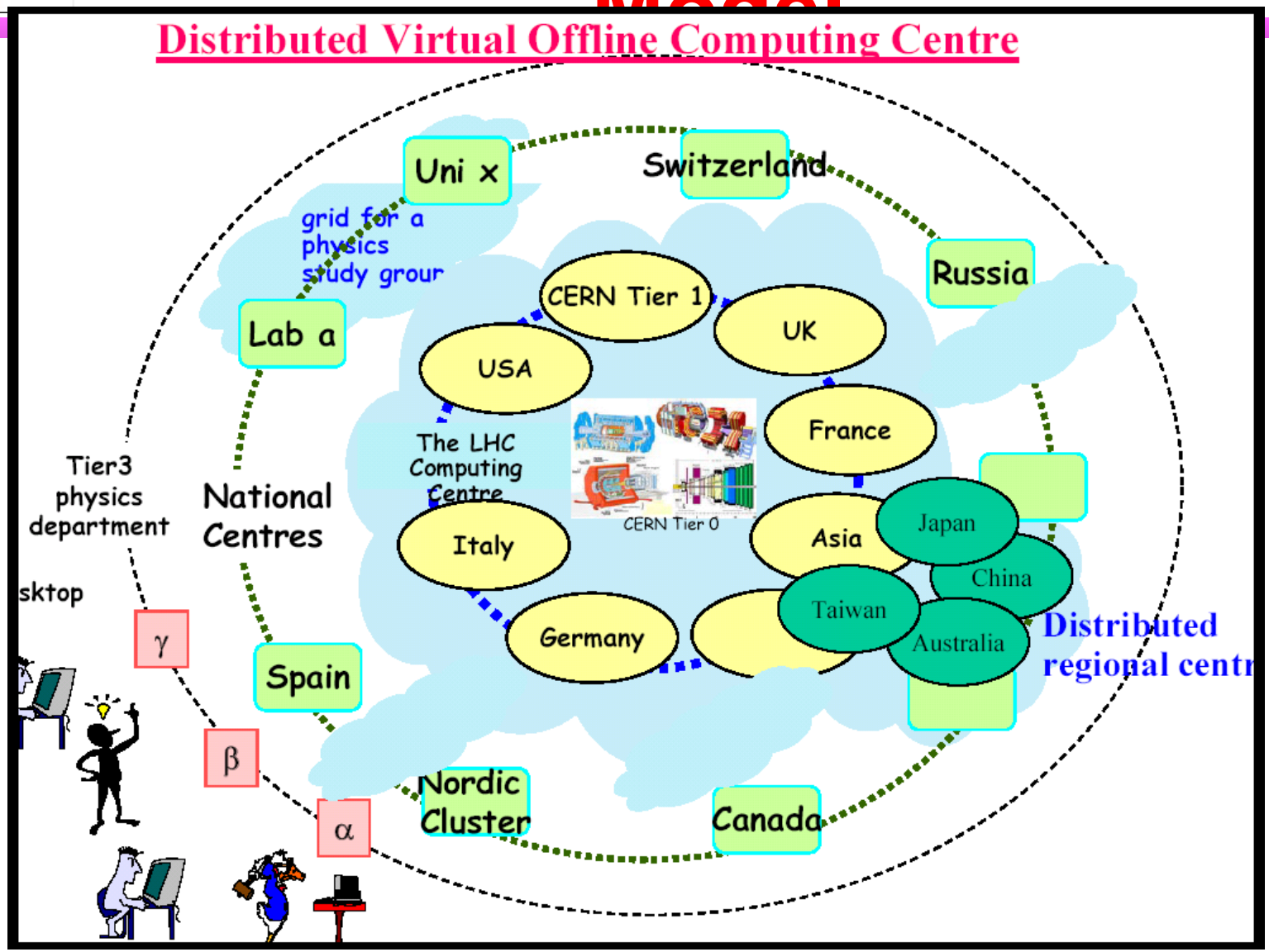
- New U.S. ATLAS Org Chart
- Tier 1: Bruce Gibbard/Rich Baker
- Software Manager: Srini Rajagopalan
  - Core Software
    - Data Management: Victor Perevoztchikov, Valerie Faine, D. Adams
    - Event Data Model: Srini
    - Production: Pavel Nevsky, Yuri Fisyak
    - Librarian: Alex Undrus
    - MAGDA (replica catalog): Wensheng Deng
  - Subsystem Specific Software
    - Liquid Argon: Reconstruction and Database: Srini, Hong
    - Muon: Ketevi Assamagan, Yuri Fisyak
- Analysis and Physics
  - F. Paige, K. Assamagan, Srini, Hong Ma

U.S. ATLAS

New ATLAS Computing Organization



LHC Computing Facilities Model



US ATLAS Regional Center At BNL

Currently

3.2 kSPECint95

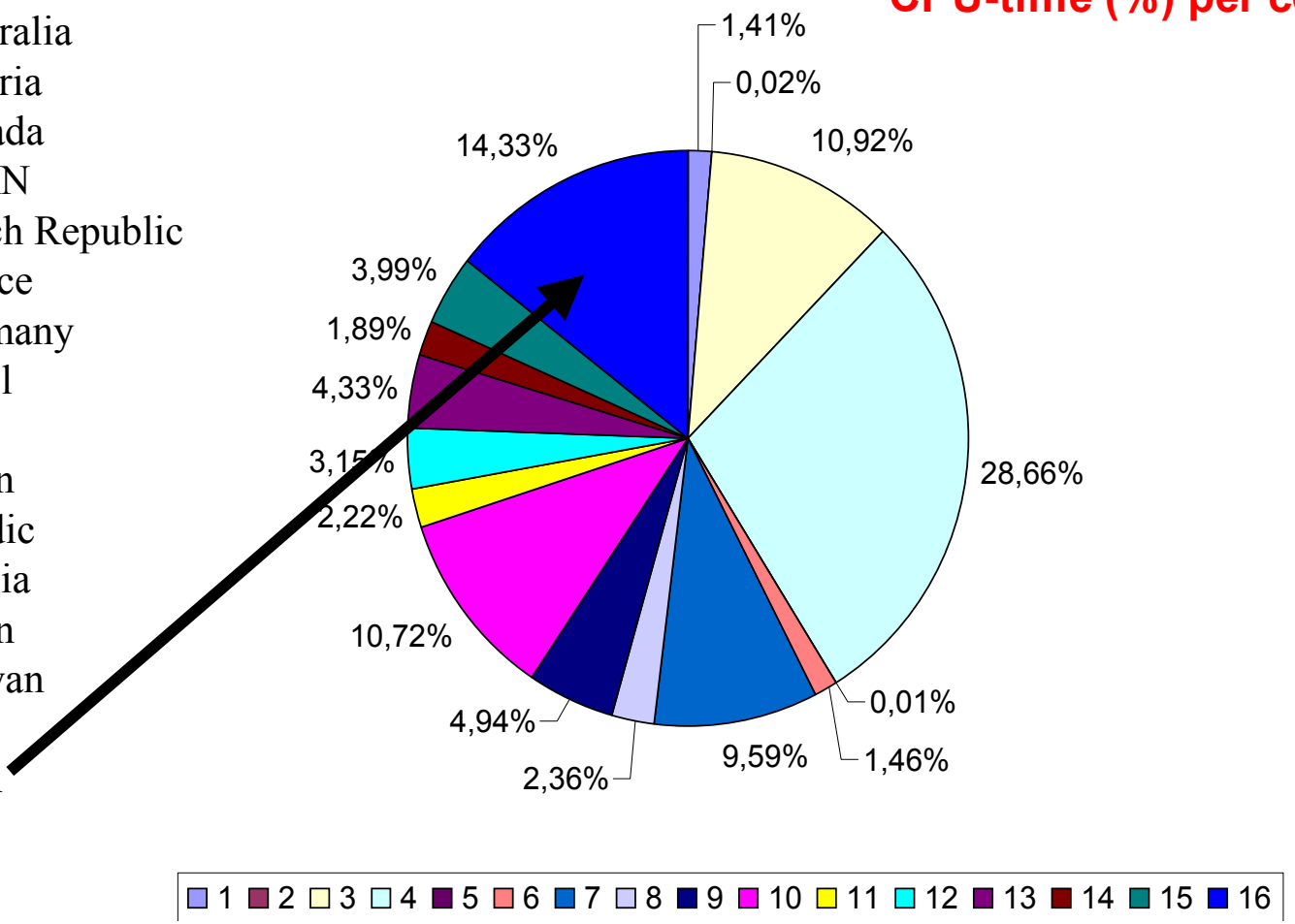
11.4 TB of Disk

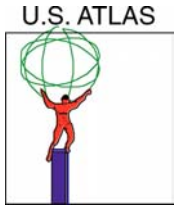
30 MB/sec Tape

ATLAS DC1 Phase 1 : July-August 2002 (A. Putzer)

Contribution to the overall CPU-time (%) per country

- Australia
- Austria
- Canada
- CERN
- Czech Republic
- France
- Germany
- Israel
- Italy
- Japan
- Nordic
- Russia
- Spain
- Taiwan
- UK
- USA





Conclusions

- **BNL is playing a leading role in U.S. ATLAS and ATLAS overall:**
  - **Physics**
  - **Management**
  - **Detector Construction → Installation→ Commissioning →M&O**
  - **Computing**
- **The erosion of the Base Program support prevents us from reaching our full potential**
- **DOE should fund BNL for an ATLAS Physics Analysis Center**