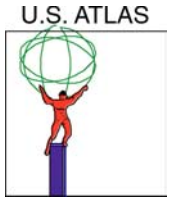


BNL's Role in ATLAS

Howard Gordon

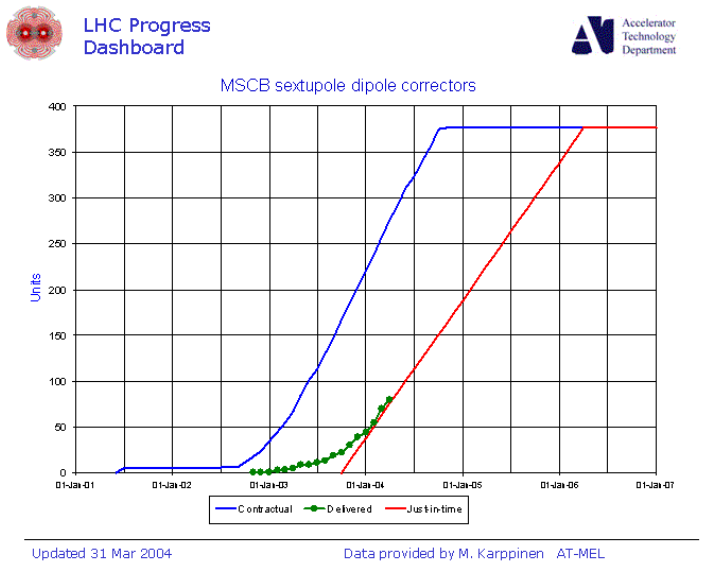
DOE Annual HEP Review

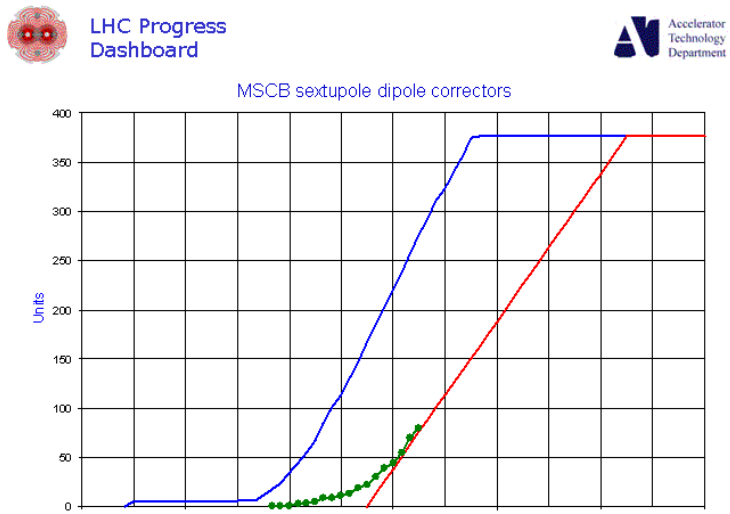
Brookhaven National Lab

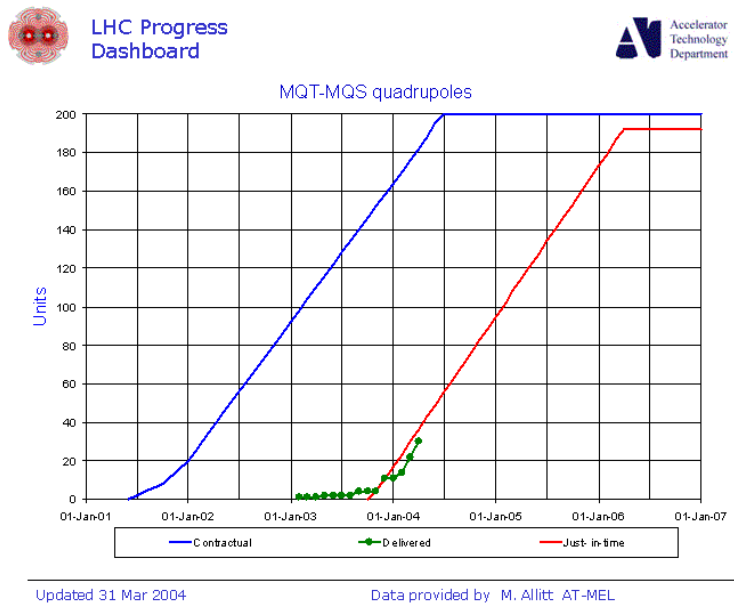
April 22, 2004

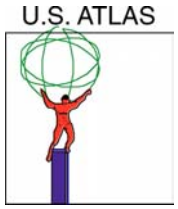
The LHC is on Schedule

- Aymar is in command!
- Early physics can be significant – we must be ready!



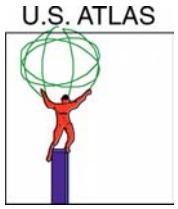






BNL's Leading Roles in ATLAS

- **BNL's Role in ATLAS** — **H. Gordon**
  - Physics & Analysis Center
    - Frank Paige will also speak about LHC physics in Parallel Session 3
    - Heavy Ion Letter of Intent Submitted – Helio Takai leading
  - BNL's Role in U.S. ATLAS Management
- **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)**
  - Tier I Center
  - Core Software
  - Analysis

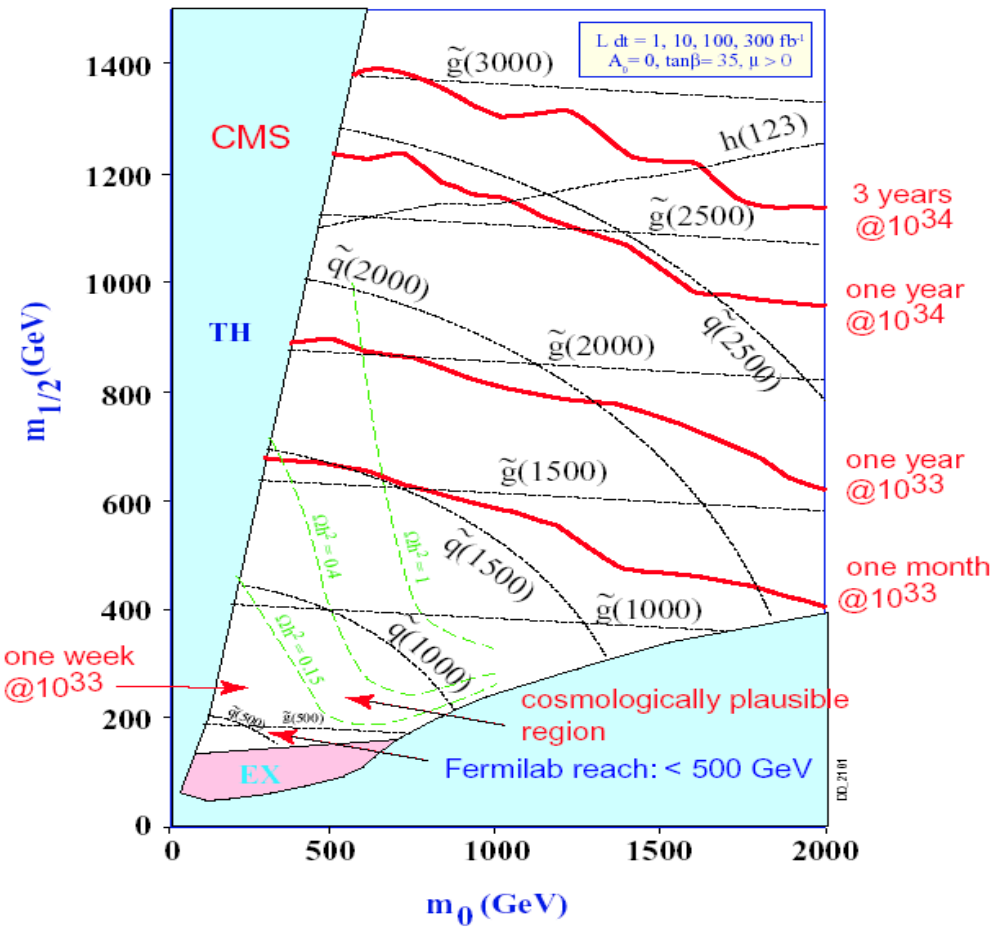


General Approach

- 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.

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.

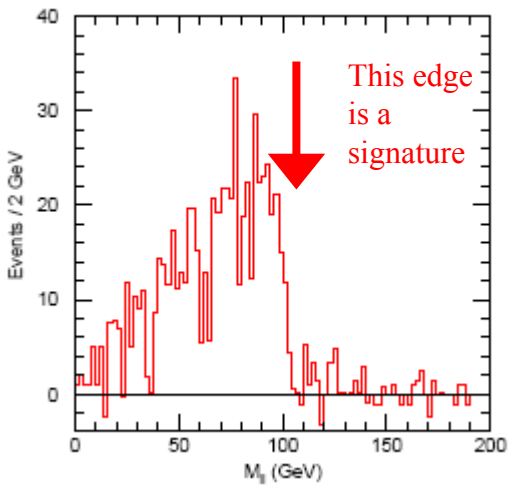
U.S. ATLAS Physics Analysis Center: Motivation

Office of Science Goal #4: Explore the Fundamental Interactions of Energy, Matter, Time and Space

- Position the U.S. universities and labs to lead in ATLAS physics analysis
- Obtaining physics from the ATLAS experiment will be an enormous challenge and will be done in large collaborations due to the complexity of the experiment.
- 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
  - CORE Software leadership at BNL.
  - Internationally recognized leading theorists who have simulating LHC physics.
- 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.
  - We have been conducting ~bi-weekly meetings with outside Universities and Labs.

ATLAS Physics Status

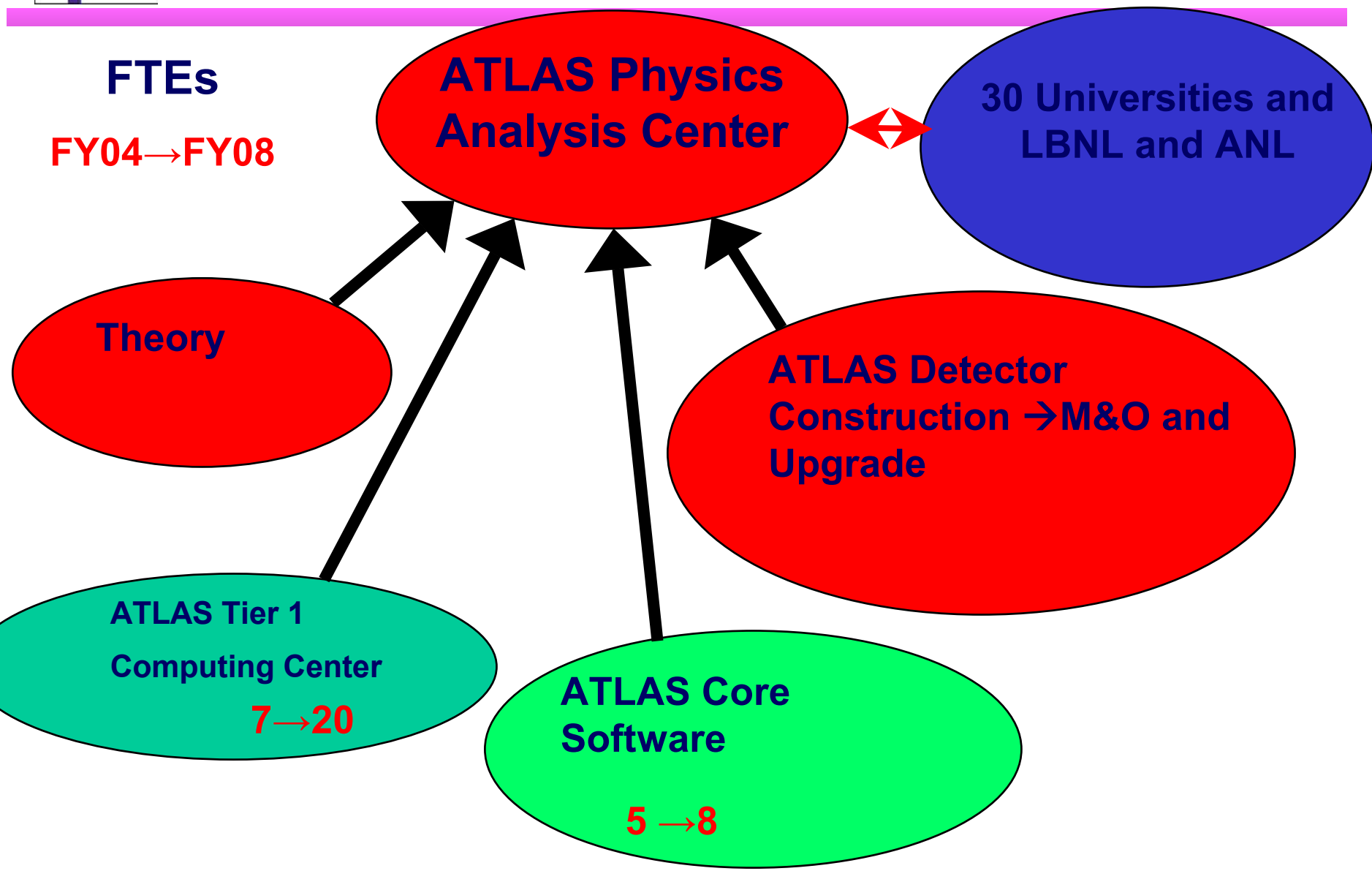
- Construction of the ATLAS Detector & basic software creation is on-track for completion on the CERN schedule to start collisions in July 2007
- U.S. scientists must now build up the capability to perform physics analysis of ATLAS data in a practical and cost-effective manner
- First exciting physics could emerge in the first year of operation



Combination of Di-lepton masses determining SUSY decays using **Full** simulation equivalent to 5 pb^{-1} (first half year) from Frank Paige (BNL)

H. Gordon , BNL DOE Annual HEP Program Review, April 22, 2004

Foundations of the U.S. ATLAS Physics Analysis Center at BNL



ATLAS Physics Topics Led by Frank Paige

SUSY Physics with Full Simulation

Use Point 5 selection cuts from *TDR*:

- ≥ 4 jets with $E_T > 100, 50, 50, 50\,\mathrm{GeV}$;
- $M_{\mathrm{eff}} > 800\,\mathrm{GeV}$;
- $E_T > \max(100\,\mathrm{GeV}, 0.2 M_{\mathrm{eff}})$.

Then expect negligible SM background, so just show SUSY distributions.

Recall $\tilde{\chi}_2^0 \to \tilde{\ell}_R^{\pm} \ell^{\mp} \to \tilde{\chi}_1^0 \ell^+ \ell^-$ has endpoint at

$$M_{\ell\ell}^{\max} = \sqrt{(M_{\tilde{\chi}_2^0}^2 - M_{\tilde{\ell}}^2)(M_{\tilde{\ell}}^2 - M_{\tilde{\chi}_1^0}^2)/M_{\tilde{\ell}}^2} = 100.16\,\mathrm{GeV}.$$

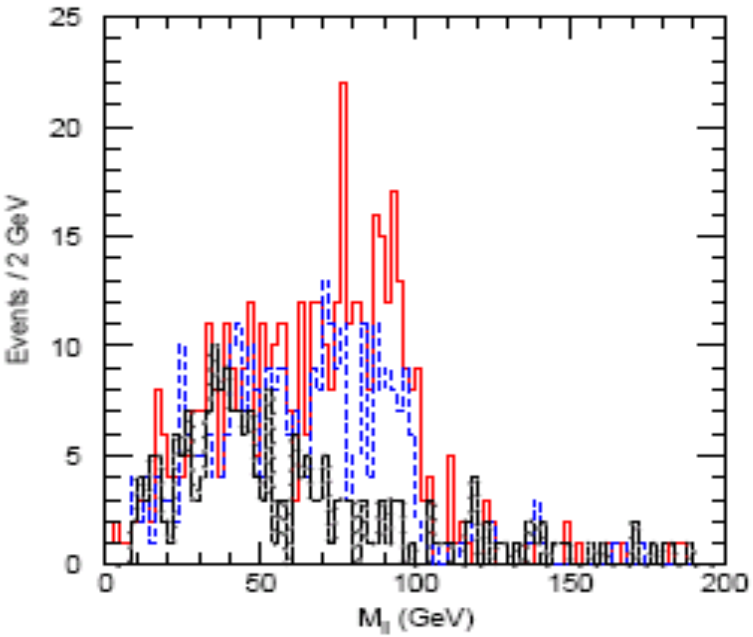
$e^+e^- + \mu^+\mu^- - e^{\pm}\mu^{\mp}$ cancels backgrounds from independent decays.

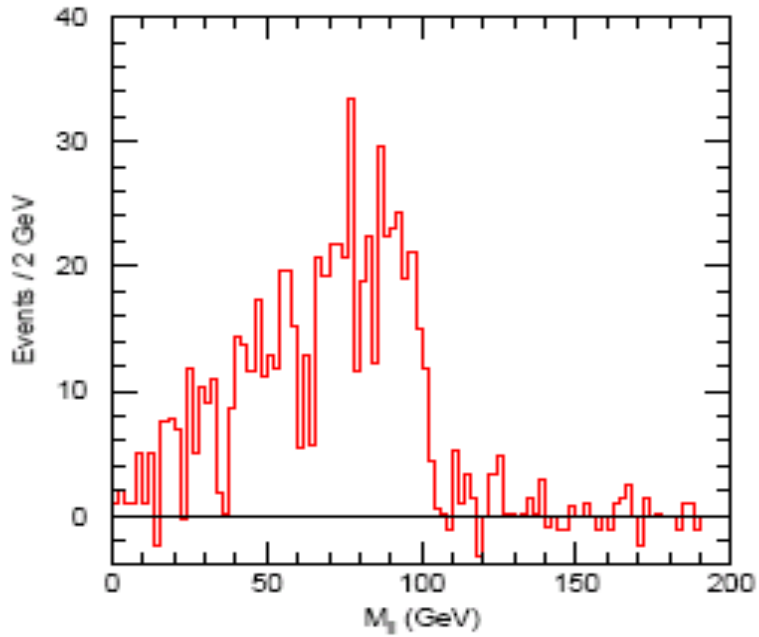
Correct E_e scale by 1.017 and weight each electron by 1.16 for relative acceptance. Then find correct endpoint after subtraction.

U.S. ATLAS

Full Simulation from DC1 with 5 fb^{-1}

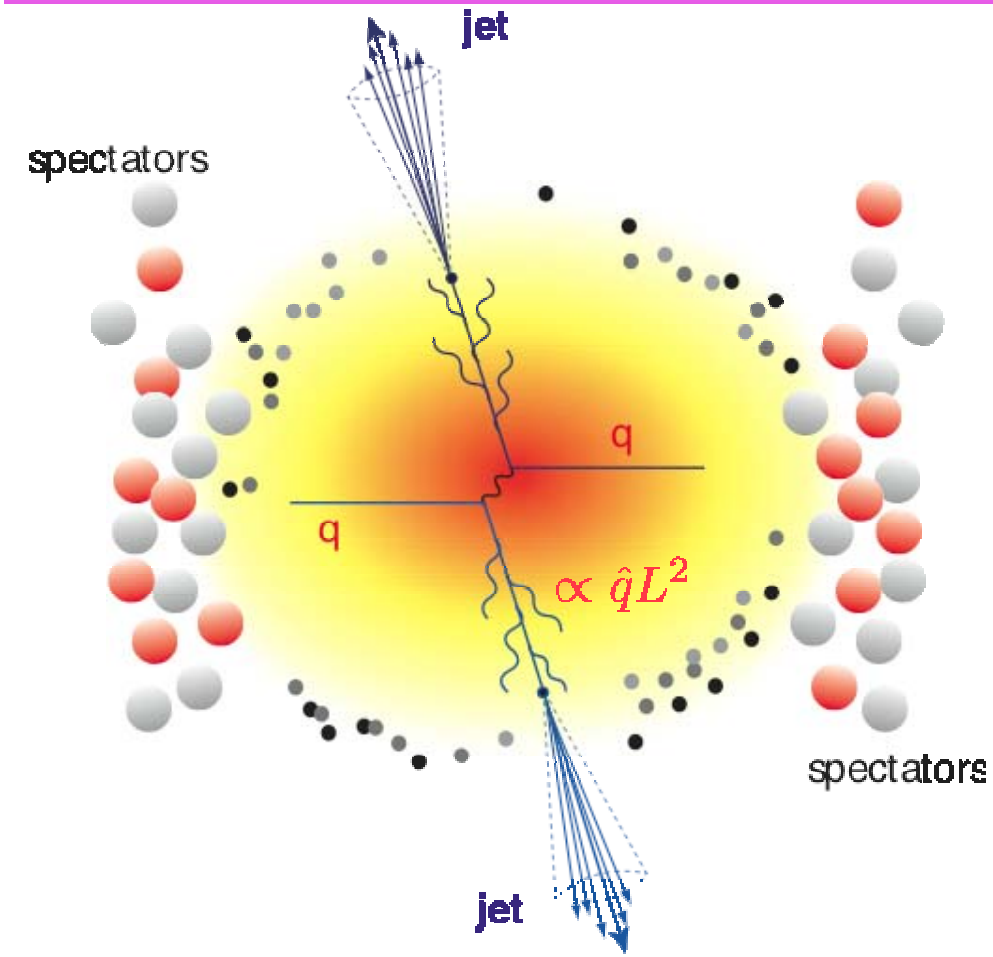
$\mu^+\mu^-$, e^+e^-, $e^\pm\mu^\mp$, and weighted $e^+e^- + \mu^+\mu^- - e^\pm\mu^\mp$ masses:





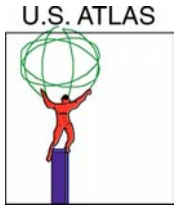
Main source of $\tilde{\chi}_2^0$ is $\tilde{q}_L \to \tilde{\chi}_2^0 q$. Assume 2 hardest jets are from $\tilde{q}_L$ and combine with dileptons. Find approximately right endpoints, but tails not yet understood.

Recently a Letter of Intent was Given to the LHCC on Heavy Ions in ATLAS



The high granularity of the calorimeter system, external muon spectrometer and tracking capabilities in the high multiplicity environment makes ATLAS ideal for the study of jets and quarkonia in heavy ion collisions.

"Quenching" = induced gluon radiation

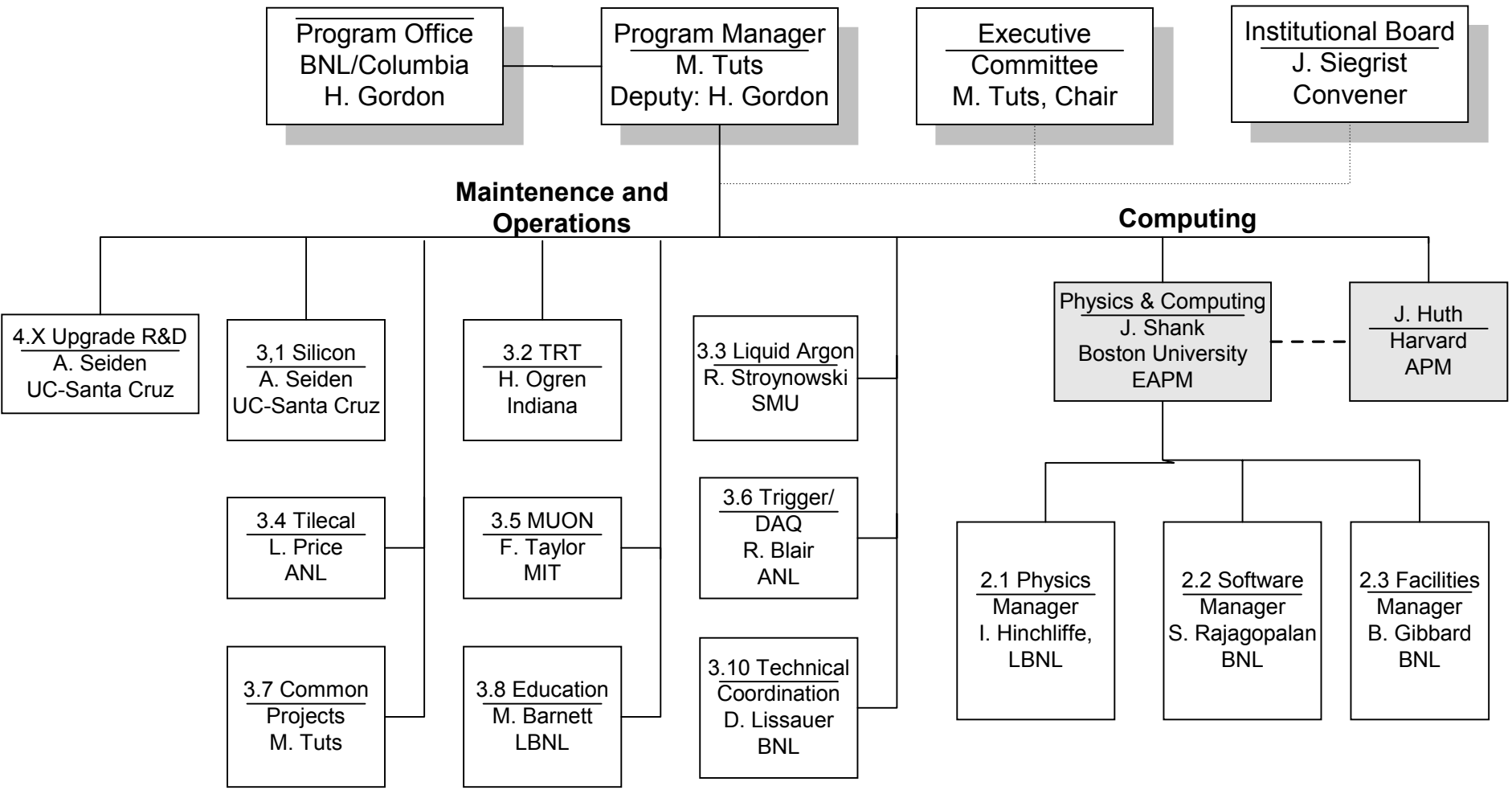


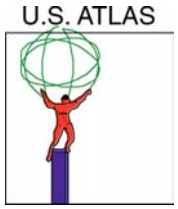
U.S. ATLAS Construction Status

- **Status of deliverables**
  - **Complete: Tilecal modules and electronics, TRT mechanical modules; LAr Cryostat, Feedthroughs, Preamps, System Crates, FCALs; Michigan and Washington MDT bare chambers**
  - **89% complete, on schedule and within cost**
  - **Will finish 97% of construction by the end of FY05 as planned**
- **Cost/Schedule performance & concerns**
  - **Cost: Pixels, Liquid Argon Power Supplies, Installation**
  - **Technical: Pixels, Liquid Argon Front End Boards, Power supplies**
- **Contingency status – still more than 35% of cost to go and enough for our baseline deliverables**

Research Program Organization

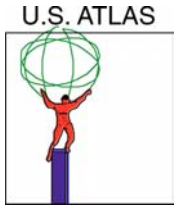
U.S. ATLAS Research Program Organization, From Sept. 1, 2004 on





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

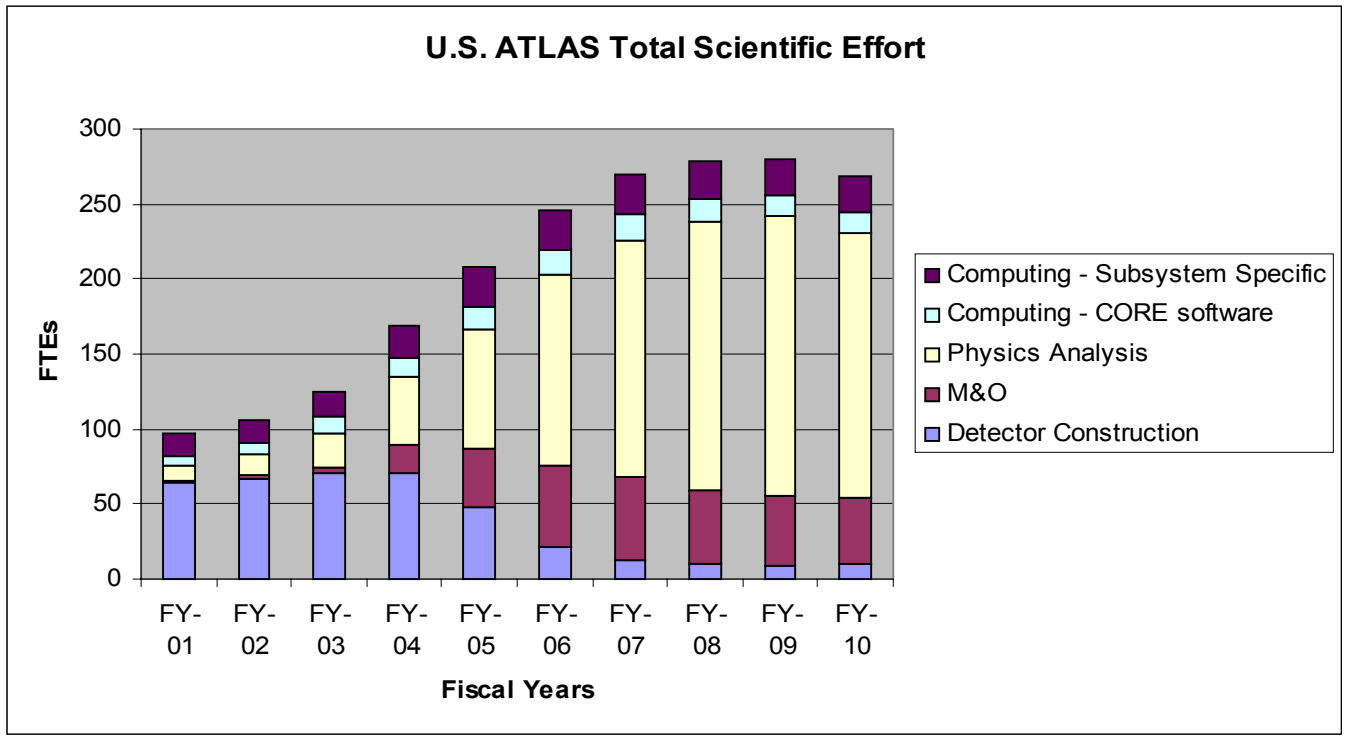
- TRT – Barrel Modules are at CERN and in pre-operations
- Liquid Argon –
  - The Barrel Cryostat has been welded closed and is beginning a first cold test – this has been delayed and impacts our M&O schedule
  - Electronics is being commissioned
  - Combined test beam this summer
- TileCal modules are all at CERN and are in pre-operations
- Muon chambers are at CERN and are in pre-operations



U.S. ATLAS Project and Research Program Management

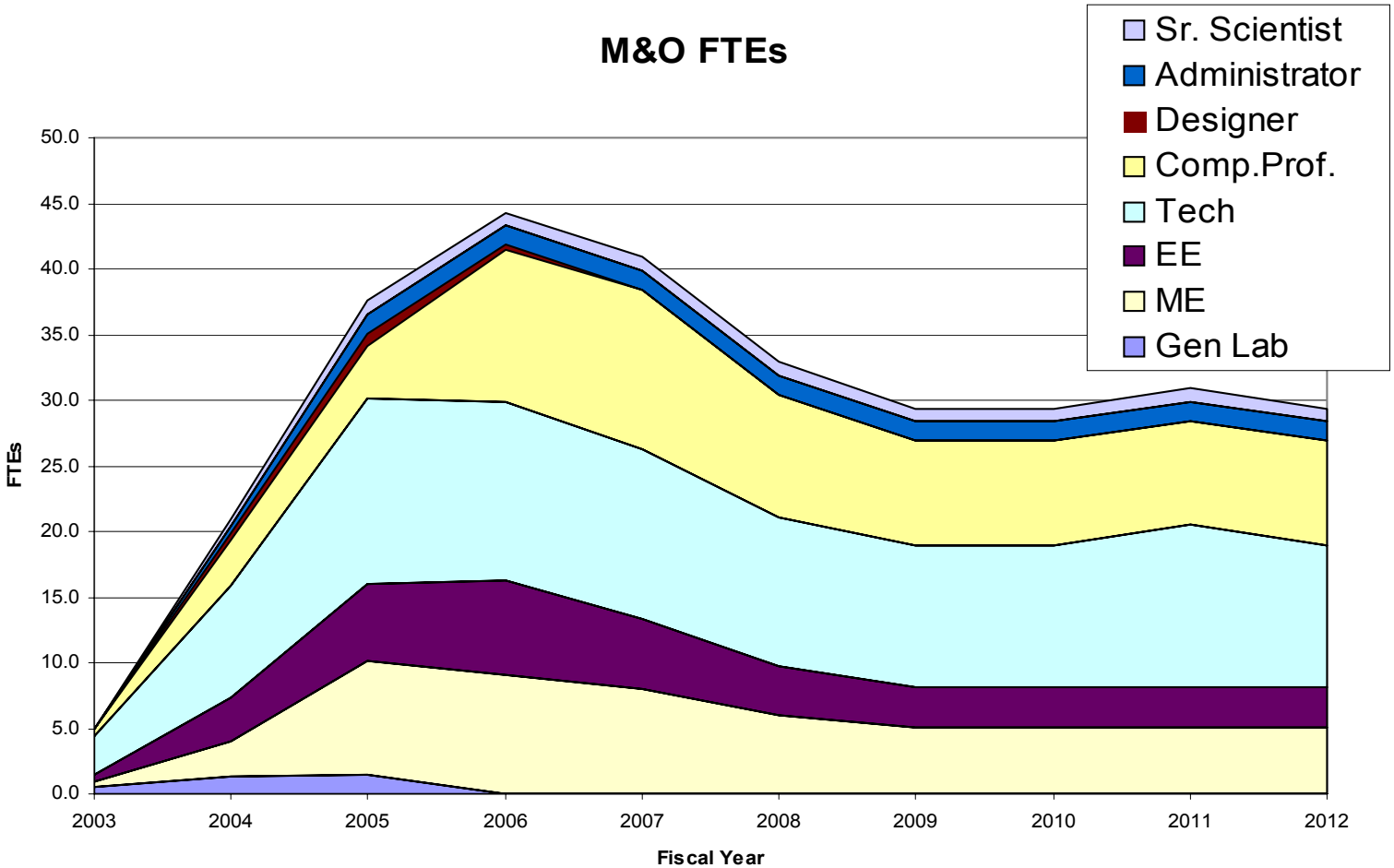
- BNL is the Host Lab for the 33 U.S. institutions in ATLAS
- We have (almost) constant reviews
- We are planning for the transition from a successful construction project to the Research Program which includes:
  - M&O – consisting of pre-operations and commissioning
  - Computing
  - Upgrade R&D
- We are responsible for (monthly) reports, budgets, MOUs, and other exercises
- We conducted a survey from U.S. ATLAS Institutions to give to give insight into the needs from the Base Program

Total Scientific Personnel by Activity



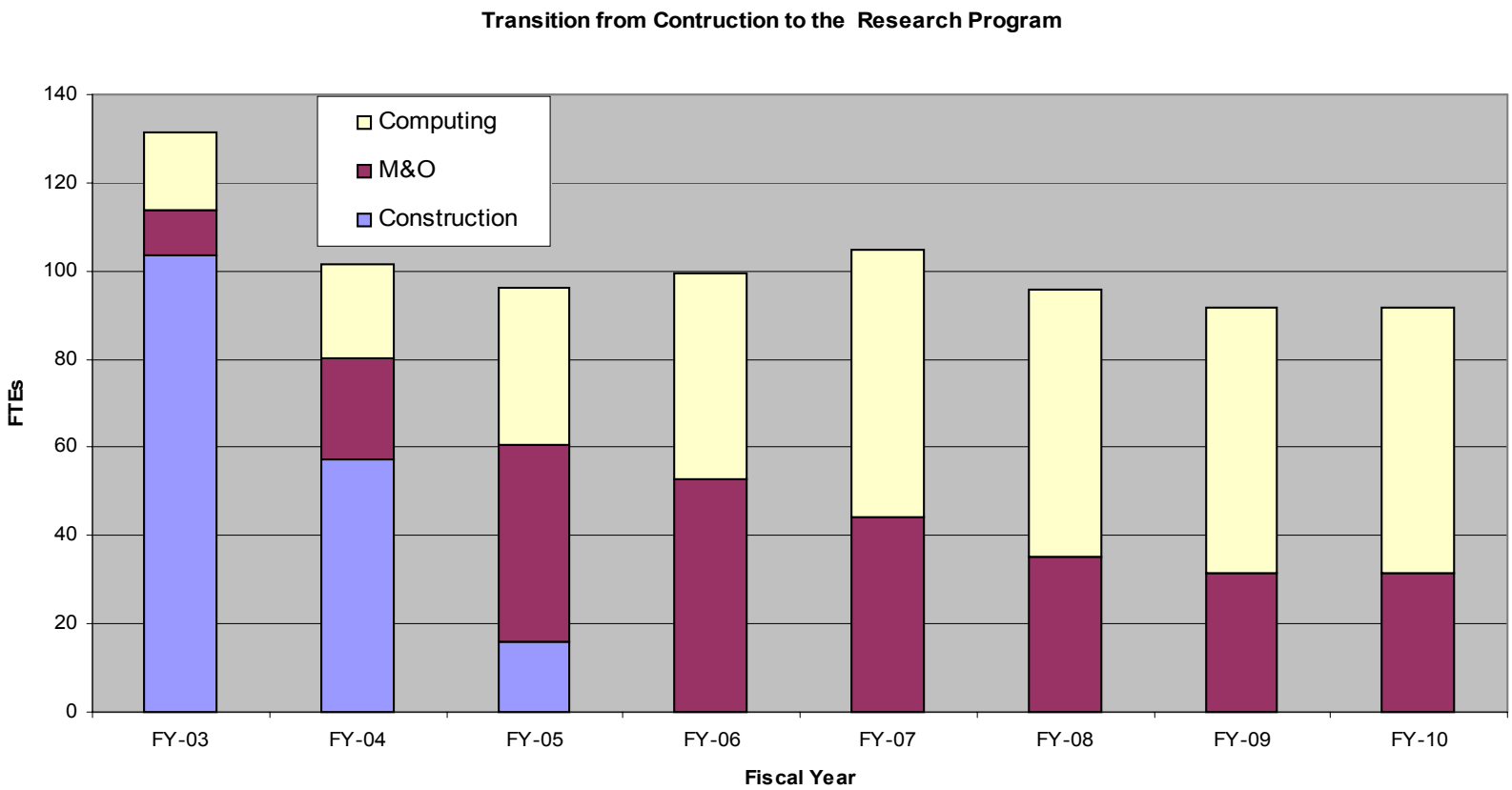
Scientists are Faculty, Research Scientists, Post Docs, and Graduate Students all supported by the "Base Program"

The Research Program: M&O



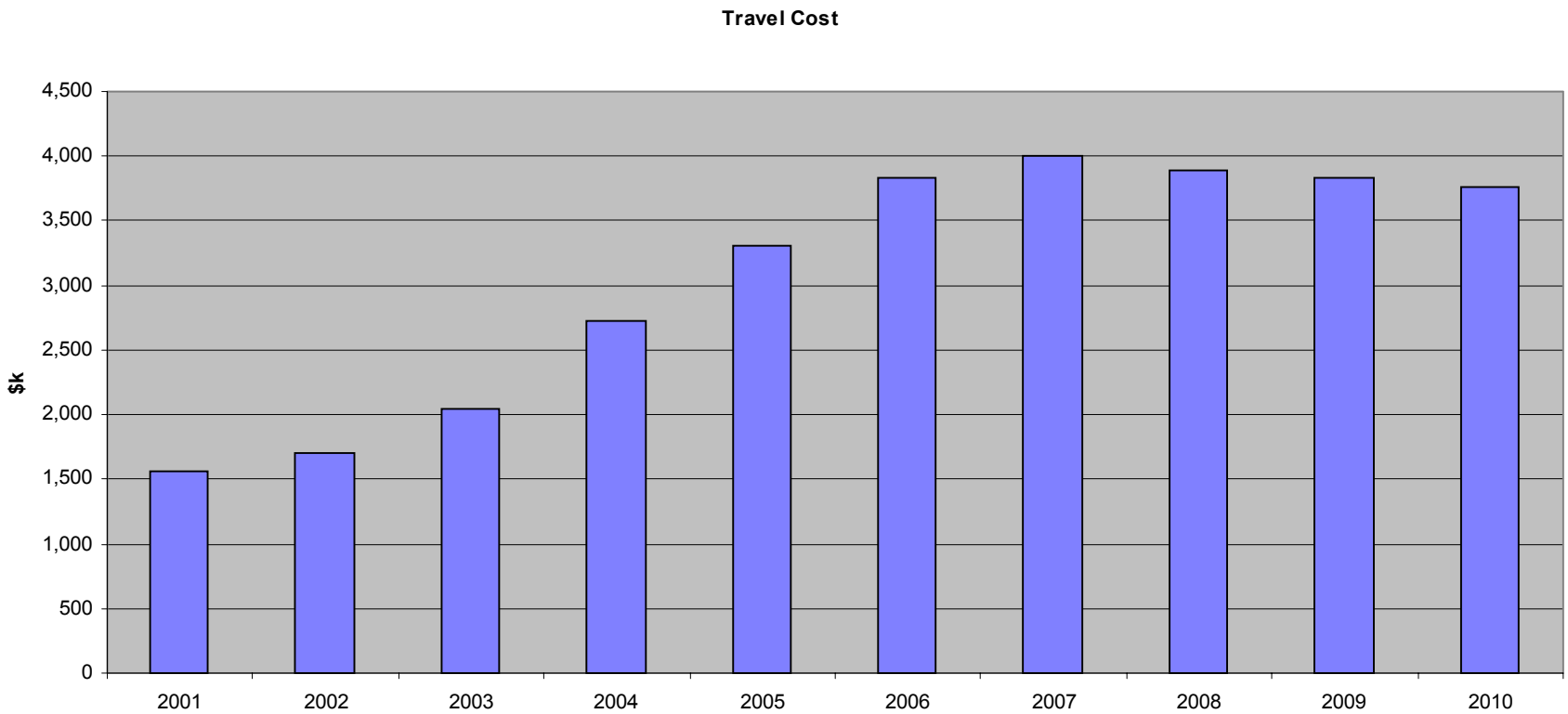
Additional Personnel supported by the U.S. ATLAS Research Program

Transition from Construction to the Research Program



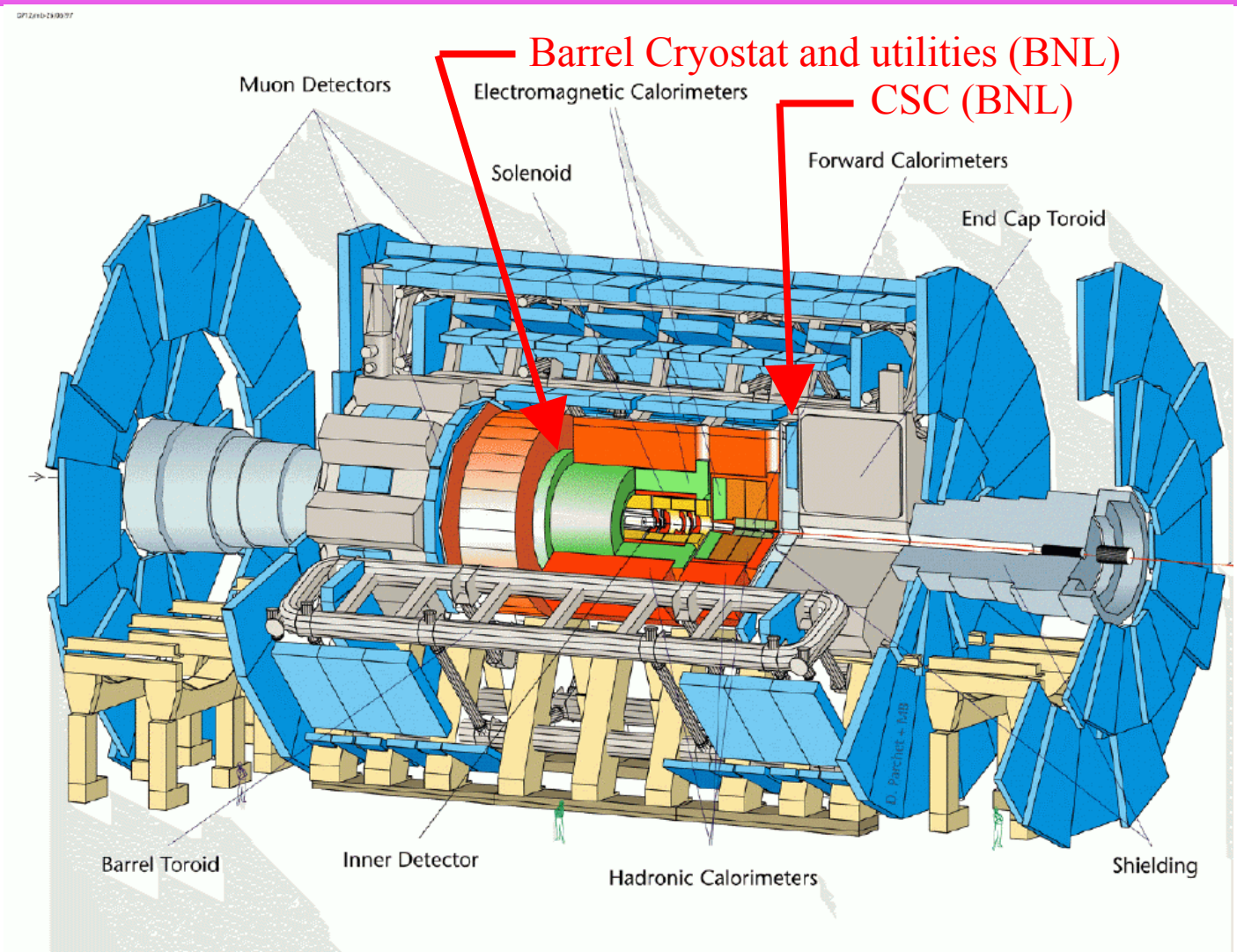
The transition requires largely different people and skills.

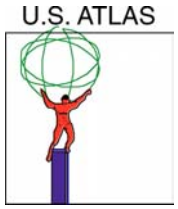
Estimate of the Increase in Travel Costs for U.S. ATLAS Scientists



U.S. ATLAS

The ATLAS Experiment

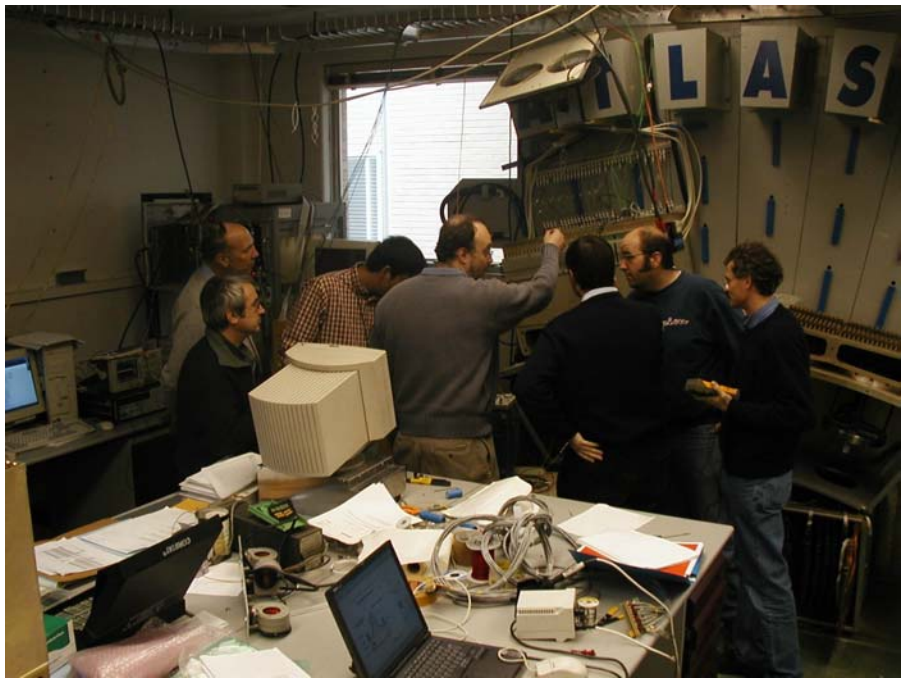




Liquid Argon - Status

- 1.3.1 Barrel Cryostat – Jack Sondericker 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 complete – Production launched
  - Cooling Plates – Production Launched
  - Integration part of System Crate Test at BNL: Front End Board Production Readiness Review Completed in March – Production Launched
- Production Database – Bob Hackenburg

Liquid Argon System Crate Test



- 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
- Technical Problem in clock timing seen first and solution verified in this setup

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

Status of Cathode Strip Chamber Production at BNL

MDT/CSC Chamber production: Status 31-Jan-04

MDT	Production bare MDT	planning bare MDT	production MDT with FC	planning MDT with FC	Production final MDT	planning final MDT
Greece - BIS	105	100	0	41	0	0
Boston - EI, EM	75	70	64	58	0	0
Univ. Michigan - EM	80	79	80	78	0	0
Univ. Washington - EI, EM	80	77	80	74	0	0
Dubna/Munich - BOS/BOF	77	73	15	30	0	0
Frascati - BML	89	76	44	39	0	0
Cosenza/Roma - BIL/BIR	46	50	29	27	0	0
Dubna - BMS	79	65	3	20	0	0
Protvino - EO	128	116	44	60	0	0
Nikhef - BOL	79	75	20	32	0	0
Cosenza, Pavia - BIL/BIR	38	43	10	21	0	0
Freiburg - BOG	0	1	0	0	0	0
Beijing - BEE, BIS8	1	1	0	1	0	0
Sum	**877**	**827**	**389**	**482**	**0**	**0**
Fraction produced (w/o EE)	**80.3%**	**75.7%**	**35.6%**	**44.1%**	**0.0%**	**0.0%**
Fraction produced (with EE)	**75.9%**	**71.5%**	**33.7%**	**41.7%**	**0.0%**	**0.0%**

CSC	panels		bare chambers	certified chambers		
	total	produced	total	produced	total	produced
	160	171	32	32	32	32

Production of CSC's completed

MDT's are being equipped with Gas distribution and Faraday cages at a reasonable rate.

Module-0 of BEE-MDT has been produced in China.

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

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

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:

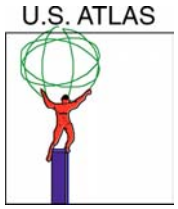
S. Norton	Senior Designer – Conf. Control
A. Gordeev	Engineer – Access
J. Farrell	Designer

ANL:

J. Grudzinski	Movements/FEA Calc.

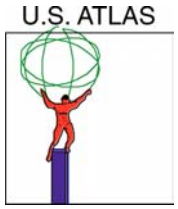
LBL:

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.***



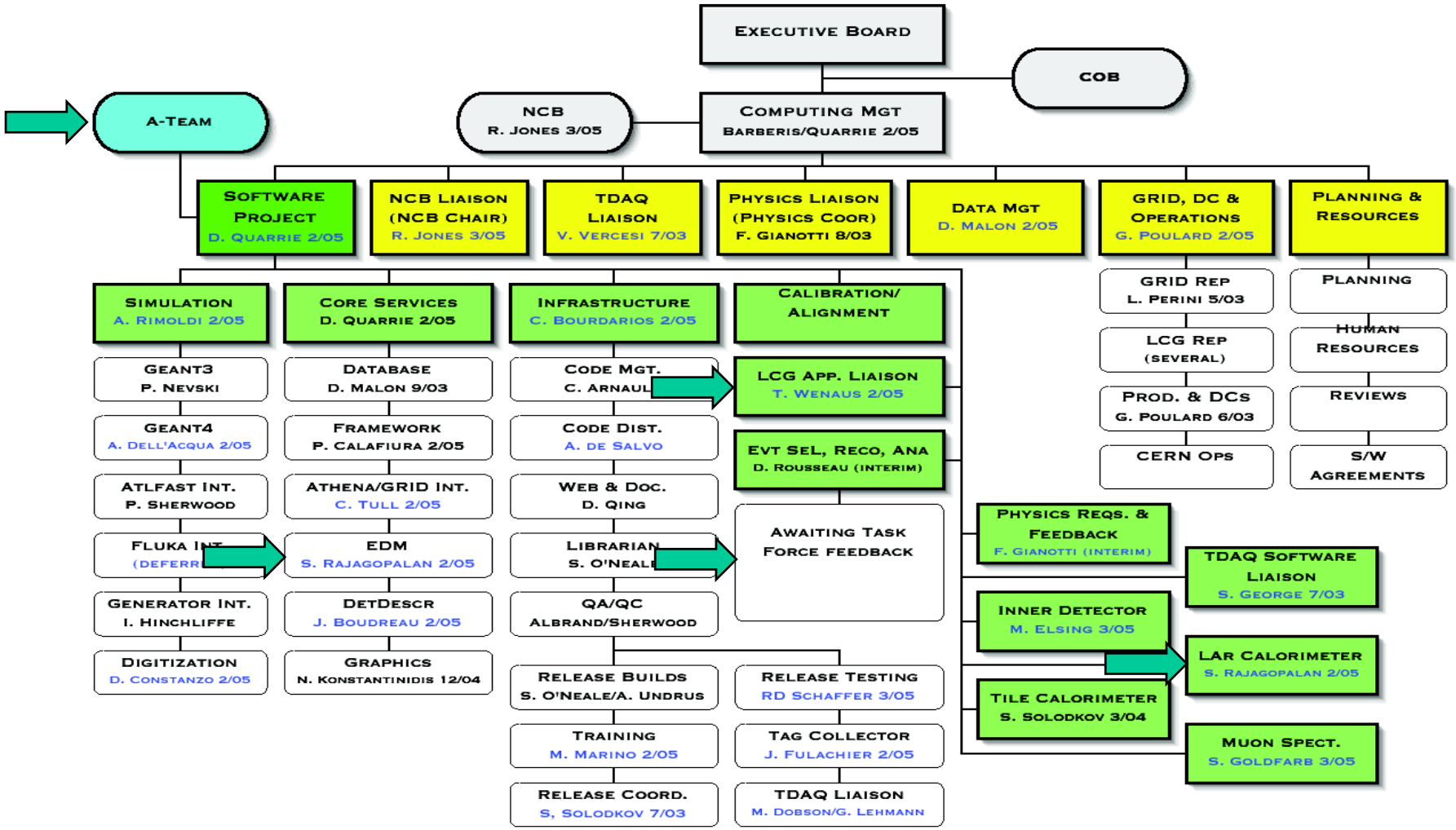
Leading BNL Roles in ATLAS Computing

D. Adams	Distributed Analysis Coordinator
K. Assamagan	Analysis Tools Coordinator
H. Ma	LAr Database Coordinator
F. Paige	SUSY Physics Group Coordinator
S. Rajagopalan	LAr Software Coordinator
T. Wenaus	LCG Applications Area Coordinator
	Now appointed also as the ATLAS Database Project Leader (May 1, 2004)

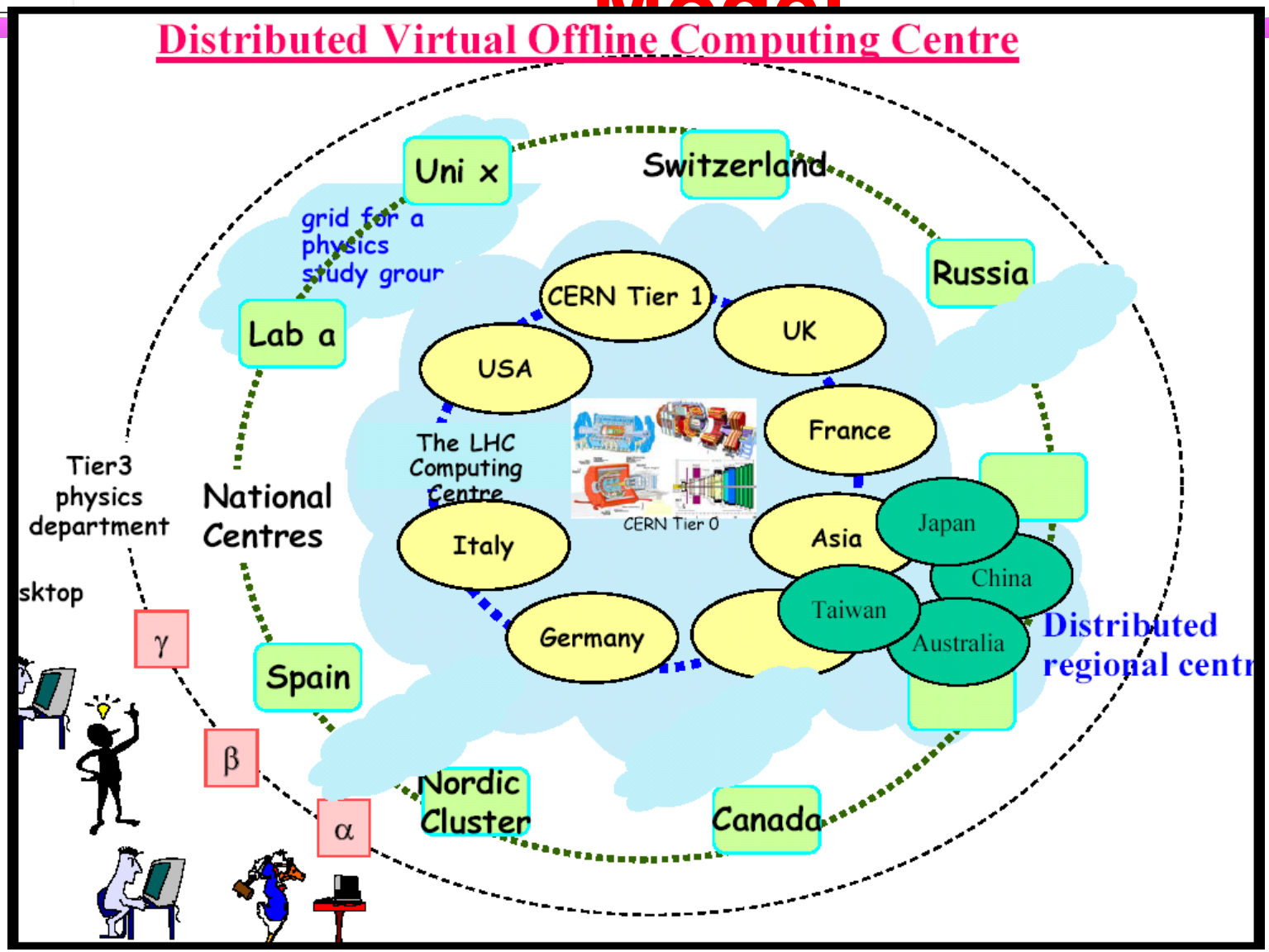
Torre and Srini are members of the ATLAS computing and software management groups respectively.

U.S. ATLAS

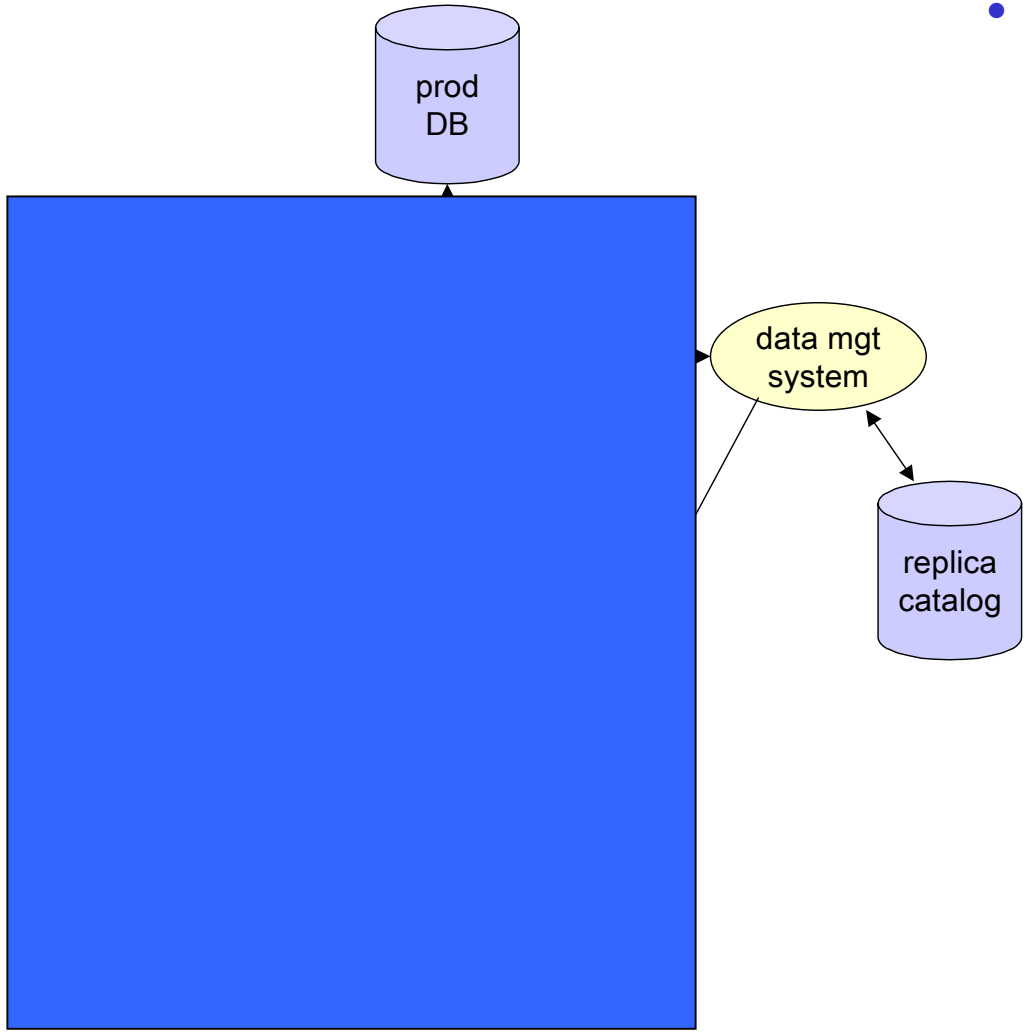
New ATLAS Computing Organization



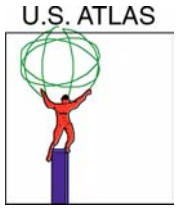
LHC Computing Facilities Model



New Production System for DC2



- **Goals**
  - **Automated data production system for all ATLAS facilities**
  - **Common database for all p r o d u c t i o n - O r a c l e**
  - **Common supervisor run by all facilities/managers - Windmill**
  - **Common data management system - Don Quijote**
  - **Executors developed by middleware experts (Capone, LCG, NorduGrid, batch systems, CanadaGrid...)**
  - **Final verification of data done by supervisor**



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 is just starting
- The erosion of the Base Program support prevents us from reaching our full potential
- DOE **MUST** increase funding to BNL for an U.S. ATLAS Physics Analysis Center