Proton Research Program

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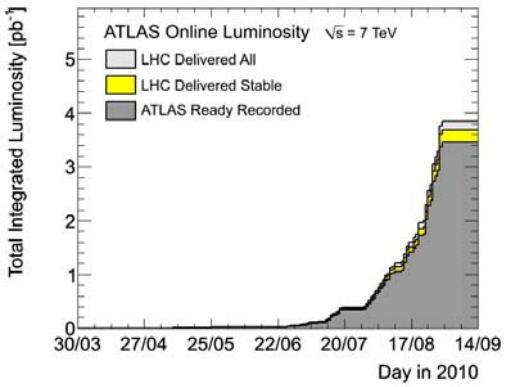
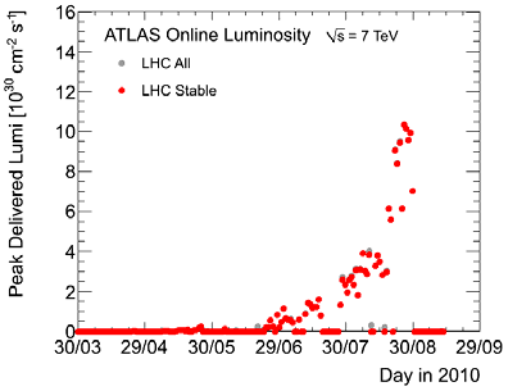
ATLAS group
Sept 13, 2010

Outline

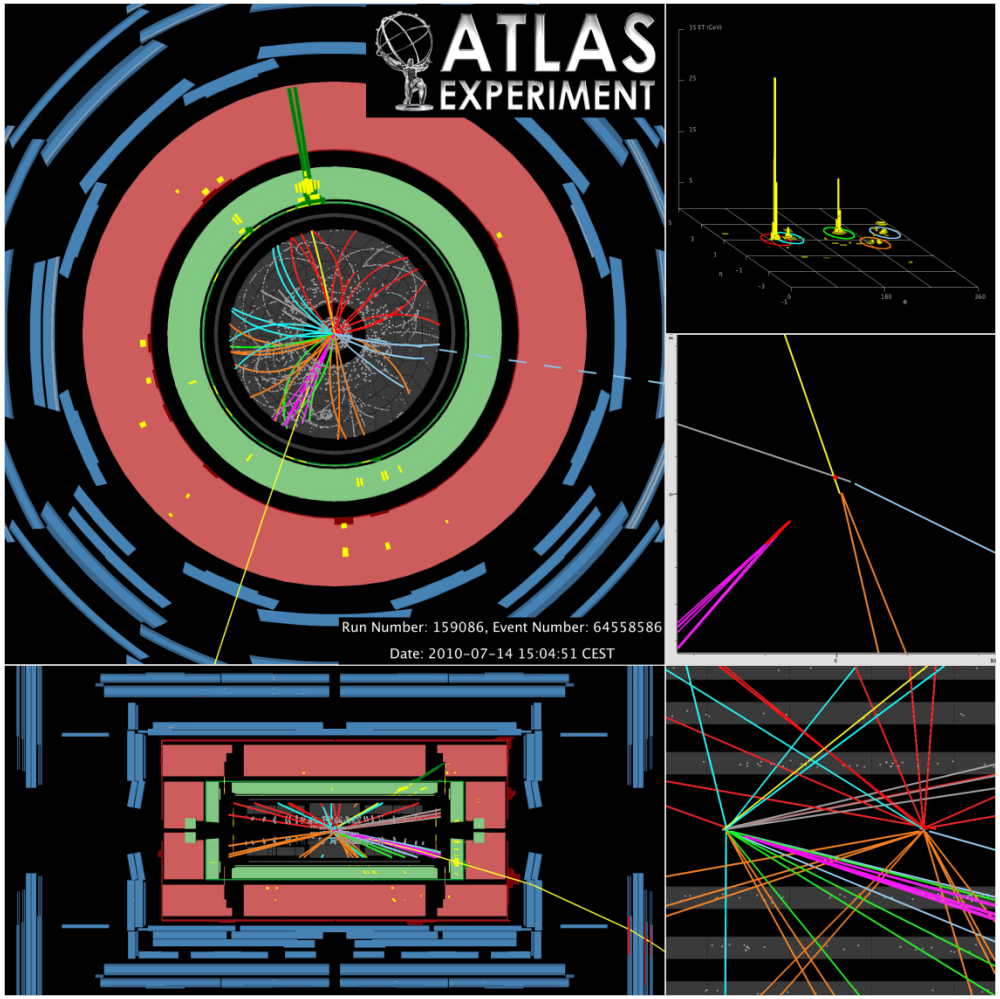
- Introduction
  - Overview of status, personnel and roadmap
- Survey of current ATLAS activities
  - Detector subsystems: pixel and tracking systems, DAQ and high-level trigger (HLT) systems, muon CSC readout.
  - Computing.
  - Data preparation: simulation, physics reconstruction and calibration.
  - First exploration of physics.
- Future direction for ATLAS program
  - R&D towards major roles for upgraded pixel and TDAQ systems
  - Future computing role and west coast center ?
- Conclusions

LHC Has Started !





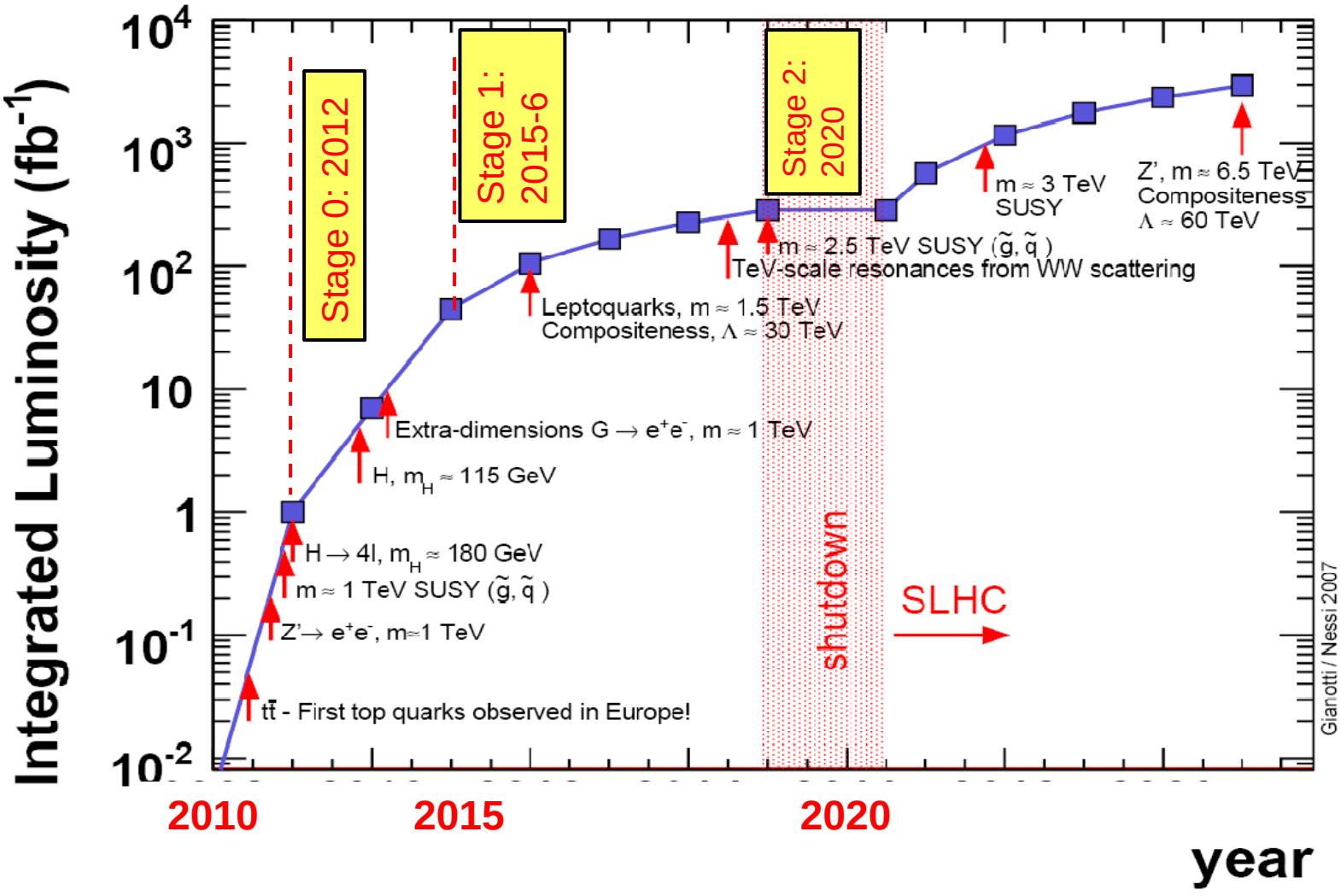
With in factor of 10 from needed $\mathcal{L}=10^{32}$ needed to integrate $1fb^{-1}$ in 2011



First Data and Detector Status

- Detector data taking efficiency > 90%.
- Sophisticated analysis on performance and physics rolled out quickly after first data.
- Detector performance in data described by simulation quite well and people are serious about any discrepancies.
- Some detector operation concerns still (ATLAS week Jul/2010):
  - -- Inner Detector cooling; Thermal Enclosure Heater pads
  - -- Pixels and SCT optical transmitters (TX) 
  - -- LAr optical transmitters (OTX)
  - -- LAr HEC noise bursts
  - -- LAr and Tile LVPS
  - -- Muon LVPS and HVPS
  - -- Magnet infrastructure (e.g. cryo-filters)
  - -- CSC ROD rate (achieved: ~ 40 kHz; goal: 75 kHz) 

Physics Roadmap and Detector Evolution



Who is involved from SLAC?

- Faculty:
  - Su Dong, Ariel Schwartzman (Assistant Prof), Andy Haas (Panofsky Fellow), [David MacFarlane]
- Scientific staff:
  - Tim Barklow, Rainer Bartoldus, Norman Graf, Philippe Grenier, Jasmine Hasi, Chris Kenney, Martin Kocian, Richard Mount, Tim Nelson, Charles Young, [Makoto Asai, Mark Convery, Michael Kelsey, Peter Kim, Tatsumi Koi, Rich Partridge, Dennis Wright]
- Technical staff:
  - Ric Claus, Andrew Hanushevsky, Mike Huffer, David Nelson, Marco Oriunno, Andy Salnikov, Douglas Smith, Matthias Wittgen, Wei Yang, {Gunther Haller, Ryan Herbst, Jim McDonald, Jim Panetta, Leonid Sapozhnikov}

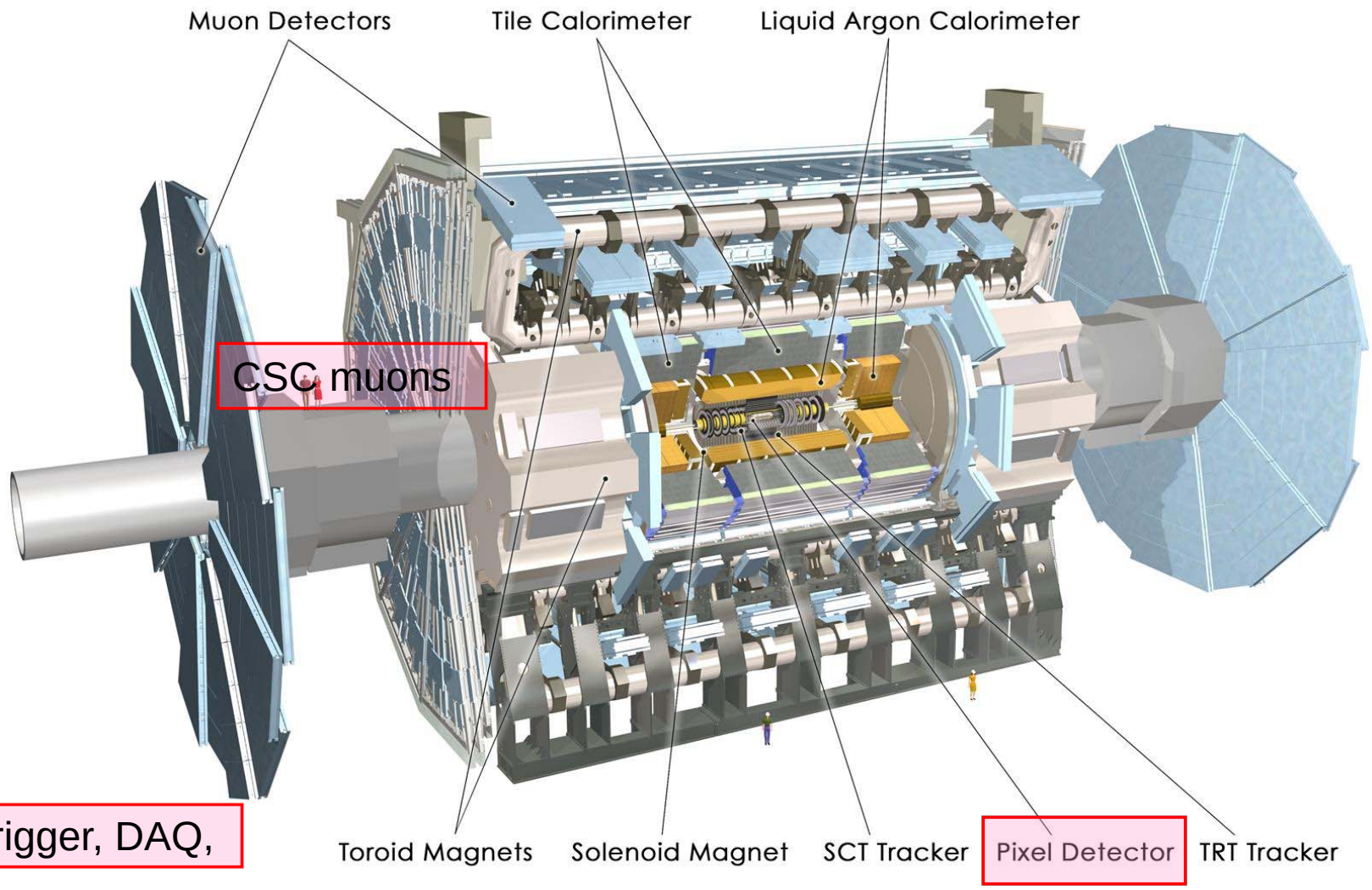
Who is involved from SLAC?

- Postdocs:
  - Ignacio Aracena, Per Hansson, Paul Jackson, Silke Nelson, Emanuel Strauss, Michael Wilson
  - Starting Jan/2011: John BackusMayes, Bryan Fulsom
  - Sarah Demers became assistant professor at Yale in 2009.
  - Claus Horn left physics in 2010.
- Graduate Students:
  - Bart Butler, Josh Cogan, Katie Malone, David Miller, Dan Silverstein + 1st year rotations.
- Administration:
  - Adrienne Higashi

What is our strategy for taking on ATLAS tasks?

- Engage in experimental tasks after weighing several different considerations:
  - Importance and urgency of ATLAS needs
  - Match to core competence at SLAC
  - Recognizing and incorporating our own ideas in defining tasks
  - Connection to our physics interests
  - Synergy with other areas of SLAC involvement
  - Synergy with future directions at SLAC
  - Synergy with local US community interests
- Not narrowly focused on one subsystem, but have tried to maximize integral impact to best utilize individual expertise
- Establish a broad base to allow future growth

Orientation: The ATLAS detector



Pixel System and tracking

- Motivation
  - Interests on b-tag related physics topics (experience from SLD/D0)
  - Experience on pixel/silicon detectors (SLD/SiD/MK-II/GLAST/BaBar)
  - Synergy with future silicon based experiment e.g. for linear collider

Current ATLAS pixel and tracking system activities:
Scientific staff: Tim Nelson, Ariel Schwartzman, Charles Young
Technical staff: Matthias Wittgen
Postdocs: Per Hansson, Claus Horn, Paul Jackson, Michael Wilson
Graduate Students: Bart Butler, Katie Malone, David Miller, Dan Silverstein

Project lead

Pixel System and tracking

Ongoing and recent activities:

- Pixel Read Out Driver (ROD) DSP software for improved calibration
- Pixel operation control interface improvements
- Pixel calibration visualization improvements
- Pixel data truncation studies and connection with DAQ problems
- Optoboard VCSEL transmitter longevity tests

Previous activities

- Pixel run coordinator and monitoring corrdinator (Charlie Young)
- Tracking alignment improvement with interactions displaced in Z
- Pixel environment monitoring software tools
- Pixel detector timing
- Pixel calibration software analysis framework and system tests
- Early pixel endcap surface cosmic test

Assisting the integration of affiliated university groups (U Iowa)

Pixel System (2012 intervention)

- The opto TX transmitter (external to ATLAS) failure rate has generated more serious concern on the longevity of the same VCSEL transmitters on optoboards inside the pixel package.
- We are helping the longevity tests.
- ATLAS is already moving towards an intervention plan in 2012 shutdown to take out pixel package to move the opto component to an accessible region and to bridge the gap with electrical links.
- SLAC is invited to contribute due to the expertise in electrical links developed with the IBL and upgrade R&D projects.

Trigger and DAQ

- Motivation:
  - Connection of trigger to physics strategy
  - Experience from BABAR in particular
  - Strong electronics and online software capability at SLAC

Current ATLAS DAQ and HLT system activities:
Scientific staff: Rainer Bartoldus, Philippe Grenier, Andy Haas, Su Dong
Technical staff: Andy Salnikov
Postdocs: Ignacio Aracena, Silke Nelson, Emanuel Strauss
Graduate Students: Josh Cogan, David Miller

Current ATLAS CSC ROD system activities:
Technical staff: Ric Claus, Gunther Haller, Ryan Herbst, Mike Huffer, Jim Panetta, Leonid Sapozhnikov

Trigger and DAQ

- Ongoing activities:
  - Online beam spot (sole SLAC responsibility)
  - DAQ partial event build for calibration (sole SLAC responsibility)
  - Online monitoring infrastructure improvements
  - Trigger menu operation managers
  - HLT trigger algorithm development: jet/Missing E_t, b-tag
- Management roles:
  - Online database/configuration manager and member of DAQ/HLT coordination group (Rainer Bartoldus)
  - DataPrep beamspot working group co-convenor (Rainer Bartoldus)
- Delivered projects:
  - CORAL server/proxy in collaboration with CERN IT for scalable HLT configuration across o(1000) computers.

Muon CSC Readout

- Was one of the major concerns of ATLAS operation with CSC Read Out Driver (ROD) not being able to take data still in late in 2008.
- Leveraging strong electronics and DAQ expertise at SLAC to engage and working with UC Irvine team as a support to university effort and US ATLAS responsibility.
- Major changes to firmware and software infrastructure and date flow strategy, with a new roadmap define Feb/2009.
- New implementation allowed first CSC cosmic data taking in summer 2009, and the performance has kept up with beam data taking until now, but max rate still at ~40Khz.
- Last week established a solution to DSP DMA performance bottleneck for ~60Khz rate capability and allow many close triggers. This implementation can potentially be improved to ~70Khz.
- Existing ROD may barely reach 75Khz without much margin. Plan established with RCE/ATCA ROD for 2013 and beyond.

Computing and Tier 2 Facility

- Western Tier-2 computing center operations
  - Have effectively more CPU capacity by leveraging existing SLAC CPUs
  - Best disk capacity among US T2s after summer-2010 installation
- Contributing to ATLAS production system improvements, and ATLAS distributed computing operations at CERN.
- US ATLAS computing Resource Allocation Committee chair (Richard Mount)

Current ATLAS Tier 2 activities:
Scientific staff: Richard Mount, Andy Haas
Technical staff: Wei Yang, Douglas Smith + SCCS personnel

Development of plan for future ATLAS computing role
Scientific staff: Andy Haas, David MacFarlane, Richard Mount, Charles Young

Simulations

- GEANT4 core support, performance enhancement and background simulations
  - Muon simulation: proper geometry volume definitions
  - physics validation, and other improvements to the code
  - Recent FLUGG effort to simulate cavern backgrounds
  - Leading next steps in performance improvement and background studies with Charlie Young as ATLAS simulation co-coordinator
- Zero-bias data event overlay to simulation and zero-bias background event sampling

Current ATLAS simulation activities:
Scientific staff: Makoto Asai, Norman Graf, Andy Haas, Tatsumi Koi, Charles Young, Dennis Wright

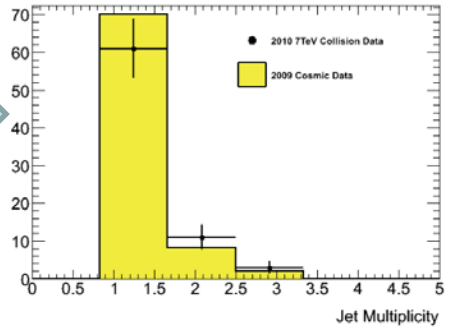
Physics Preparation Activities

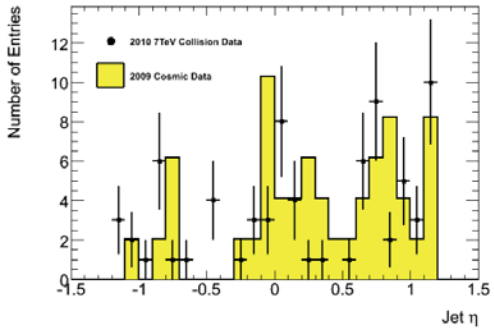
- Emphasis on building expertise on physics signature reconstruction, trigger and simulation:
  - Grass root Jet/MissingEt/b-tag analysis group evolved into a core workforce in ATLAS jet/MET working group with a wide range of innovative contributions. (Ariel Schwartzman's DOE early career award)
  - ATLAS jet energy calibration task force coordination (*Ariel Schwartzman*)
  - Trigger algorithm (jet/MET/b-jet) and menu development
  - Online beam spot
  - Tracking and alignment
  - Pileup study / simulation
  - Overlay of zero-bias data event to simulation

Current physics analysis topics

With a strong emphasis on new physics searches and novel analysis approaches.

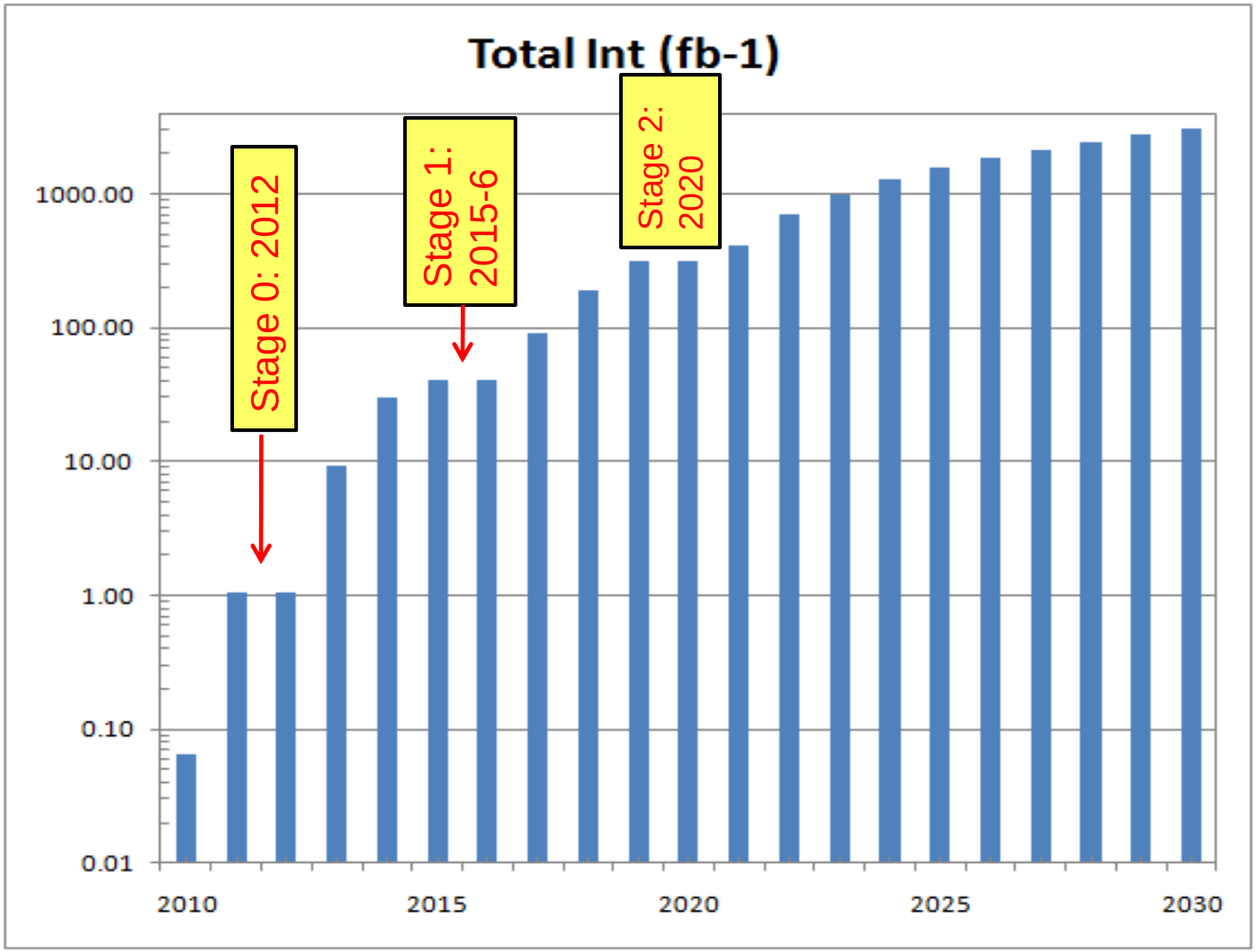
- Stopped gluino search
- New physics search with b-jet + MET





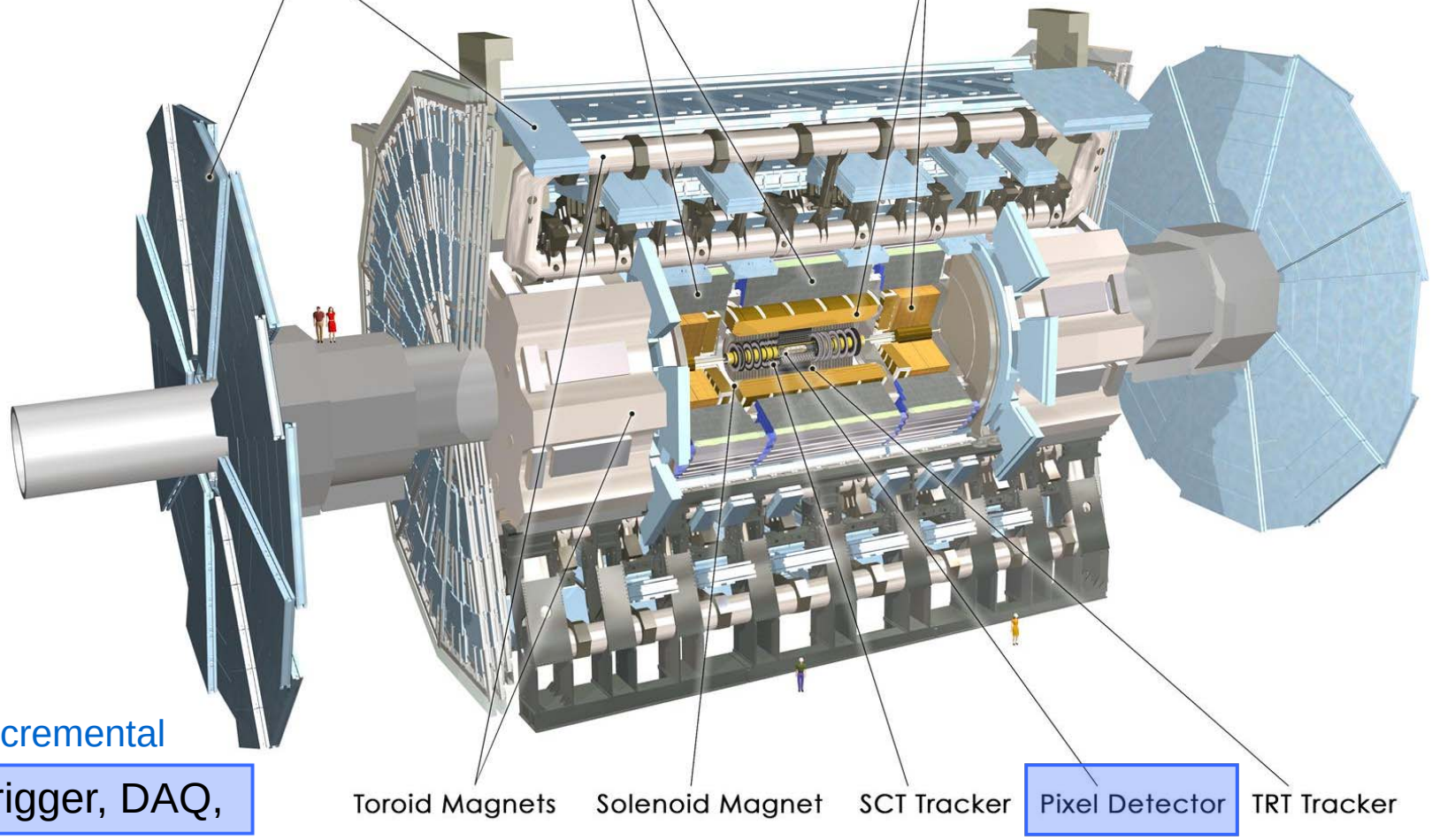
- R-Parity Violating SUSY search with displaced vertices
- (tW)($\bar{t}$W) same sign dilepton search
- Lepton jets
- Jet substructures

LHC luminosity and upgrade planning

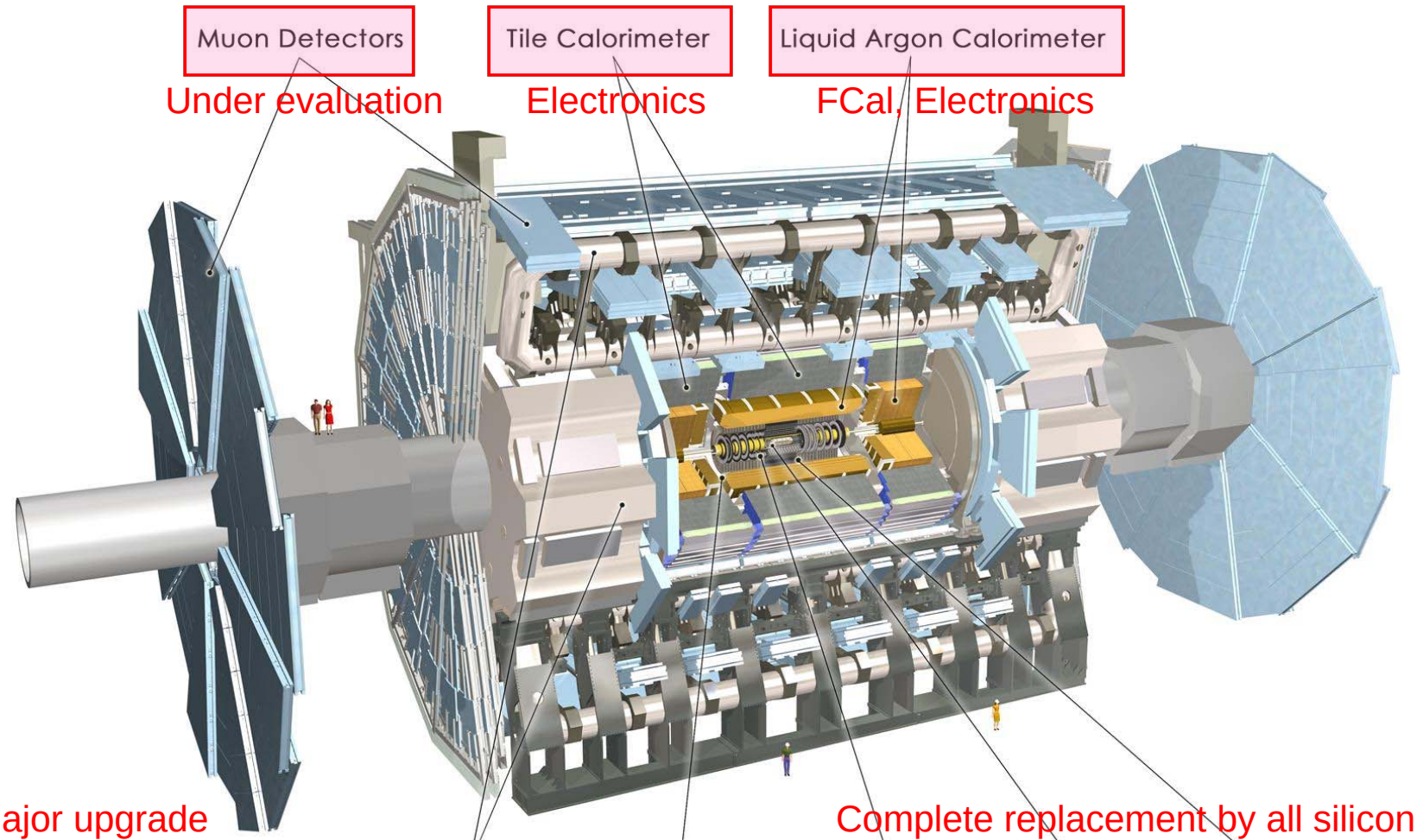


Steve Myers ICHEP 2010

Potential Phase 1 US ATLAS upgrade projects



Potential Phase 2 US ATLAS upgrade projects



Upgrade Pixel System and Tracking

- Stage 1: Pixel Insertable B-Layer (IBL) development:
  - Radiation hard 3d silicon sensors
  - Inner services and data transmission
  - CO2 cooling test stand and stave thermal tests
  - Tracking upgrade test stand and DAQ
- Stage 2:
  - Tracking upgrade mechanical designs
  - Pixel upgrade data transmission and stave electrical design
  - Silicon strip detector barrel stave electrical design and readout
  - Tracking upgrade simulation and layout

Future IBL and full pixel upgrade R&D activities:

Scientific staff: Mark Convery, Philippe Grenier, Per Hansson, Jasmine Hasi, Paul Jackson, Chris Kenney, Martin Kocian, Emanuel Strauss, Su Dong, Matthias, Wittgen, Charles Young

Technical staff: Jim McDonald, David Nelson, Marco Oriunno

Upgrade DAQ and HLT

- Some initial directions for DAQ and HLT upgrade

  Challenge of growing data rate:

  – ~200 interactions per beam crossing after stage-2 LHC upgrade

  – HLT farm already needed 2000 computers at phase 1 and currently envisaged future growth primarily through number of cores per CPU is a serious concern

  Possible approaches:

  – Continuous improvements with adiabatic upgrades expected.

  – Much improved HLT computing resource usage

  – New DAQ infrastructure

Future ATLAS DAQ and HLT system R&D activities:
Scientific staff: Rainer Bartoldus, Martin Kocian, Andy Haas, Su Dong
Technical staff: Ric Claus, Gunther Haller, Mike Huffer, Jim Panetta, Andy Salnikov, Matthias Wittgen

Tier 2 and Analysis Facility

- ATLAS Tier 2 center funding model
  - Present ATLAS T2 is ~20% of BaBar computing. The present support model will not scale into the future.
  - The latest SLAC scientific computing future support plan still has a very uneasy support:hardware ratio [next slide].
- Future evolution of ATLAS computing
  - Significant reprocessing for physics tools & algorithm development
  - Calibration & trigger development with calibration data streams
  - Interaction of T2 with T3. Hosting T3 with T2 ?

Are there viable avenues to benefit from the extensive computing infrastructure at SLAC to effectively serve various ATLAS computing needs with expanded capacity ?

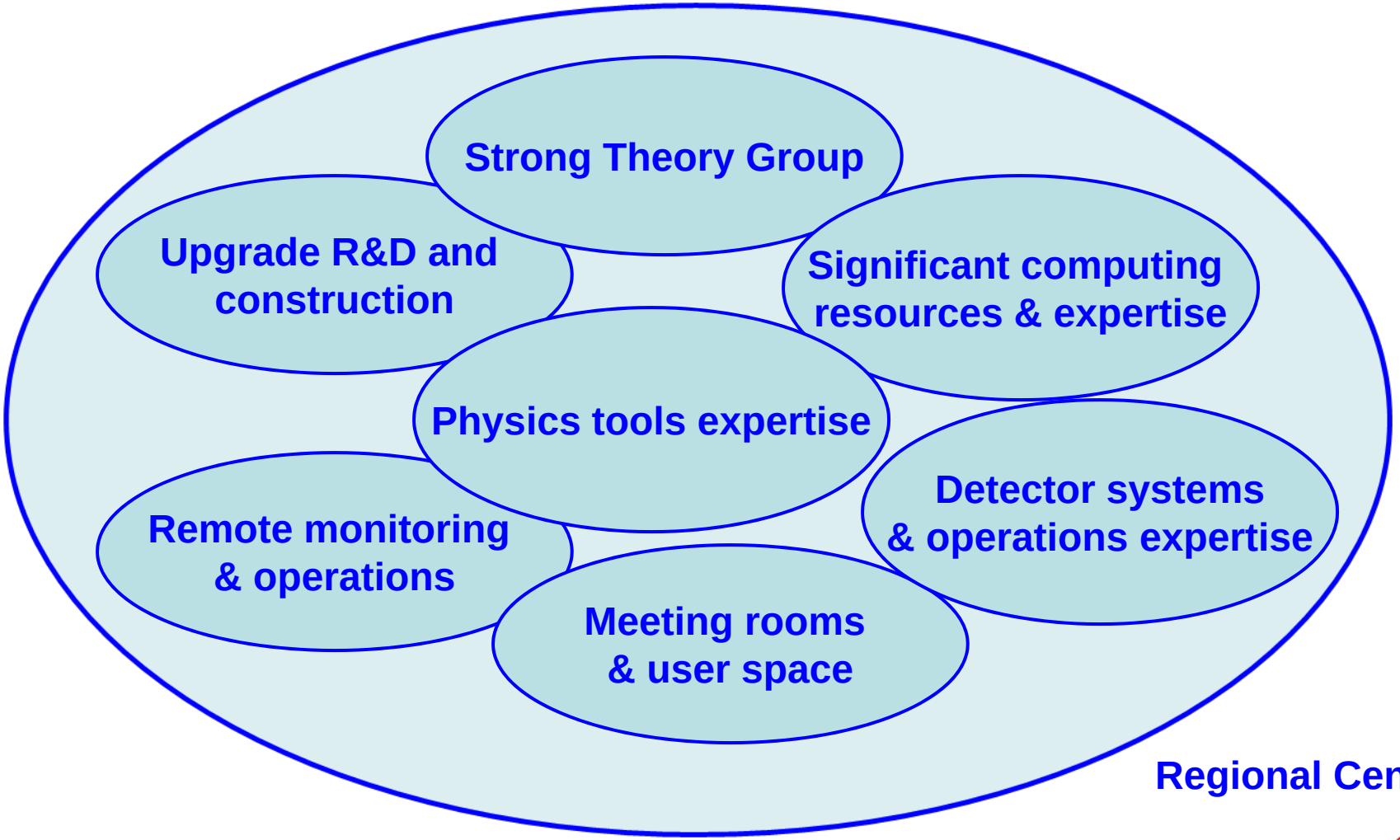
SLAC Tier-2 Support Costs

- SLAC has a group of ~22 FTEs to support for operations for Scientific Computing at its current installed size
  - Recently completed a bottoms-up assessment of services and corresponding effort
  - Allowed an evaluation of what services are needed by all science activities on the site versus costs associated with large users
  - Important long-term goal is to maintain SLAC as an attractive site for hosting large-scale scientific computing
- Have now agreed on a new cost-sharing model for FY11 and beyond
  - About 16 out of the 22 FTEs and $600k M&S will be moved to indirects without a rate increase
  - Remaining 6 FTEs will be cost shared by users
  - Recharge costs for the ATLAS T2 will be held reduce to about $180k in FY11, over and above the current $600k/year T2 budget plan

Bay area as a west-coast ATLAS center

- CERN cannot host major portions of the LHC collaborations long term
- The Bay Area could play a leading role in supporting LHC physics
  - Concentration of expertise on computing, analysis and detector systems
  - Proximity of physics analysis support centers, capability for hosting workshops, tutorials and seminars
  - Attractive training centers due to a combination of tutorials, available expertise, & participation in upgrade activities
  - Strength of Theory Groups & their strong interest in LHC physics
- Working to create a consensus in the US ATLAS community for a viable regional center role

Elements of a west-coast center?



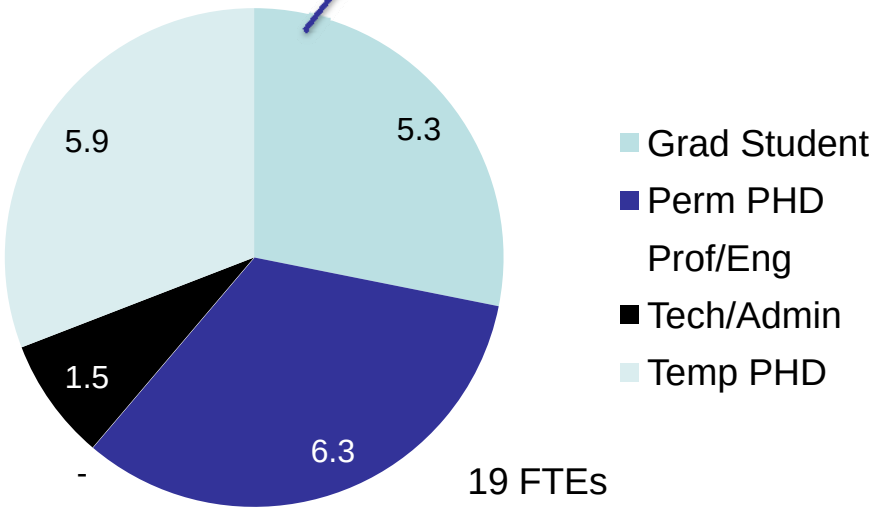
Recent Events at SLAC

- ATLAS Regional Hadron State Analysis Forum
  - Aug/23-27/2010
  - Joint Monday session 50 experimental + theory participants
  - ATLAS international sessions 21 participants
- ATLAS Trigger&DAQ week at SLAC
  - Nov/15-19/2010
  - Site selection was from TDAQ system institutional board votes
  - Expecting ~100 participants from global ATLAS.
- A joint proposal of SLAC/Santa Cruz to host the global ATLAS week during Oct/2011 was submitted last week

Financial Summary

B&R	Description	FY 2009 Funding	FY 2010 Funding	FY 2011 Requested'	FY 2012 Scenario A' Super B
KA1101021	Atlas Research	$ 5,312	$ 3,959	$ 4,100	$ 4,133

FTE by Type



19 FTEs

ATLAS M&O and Tier-2
4.2 FTE labor
$352K equipment + M&S
Total = $1,509K
Including $600K for Tier-2

Ariel Schwartzman's early career award $500K/yr

Summary

- Active participation in a wide range of current ATLAS activities and looking forward to first physics.
- Engagement in upgrade R&D covering all phases of upgrades to maintain flexibility to adjust to LHC plans.
- Migration of core manpower to further establish the role of a national lab is currently limited by budget constraint.
- Computing support evolution for ATLAS T2 remains challenging. SLAC infrastructure can still be effectively used by hosting a significantly larger computing facility ?
- Regional center concepts for enhancing US role in the LHC is not a demonstrated or accepted paradigm
  - Working with SLUO and US ATLAS to better understand needs of the US community