ATLAS Activities Involving SLAC

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The ATLAS Experiment

MAGNETS
- 8 Barrel Toroids
- Central Solenoid
- End Cap Toroids

MUON SYSTEM
- Monitored Drift Tubes (MDT)
- Cathode Strip Chambers (CSC)
- Resistive Plate Chambers (RPC)
- Thin Gap Chambers (TGC)

INNER DETECTOR (ID)
- Pixels
- Silicon Strip (SCT)
- Transition Radiation Tracker (TRT)

CALORIMETERS
- EM - Liquid Argon – Lead
- HAD - Scintillator Tile

Diameter 25m
Length 46m
Weight 7,000 tons
ATLAS Collaboration
(Status April 2009)

37 Countries
169 Institutions
2815 Scientific participants
(1873 with a PhD)

Albany, Alberta, NIKHEF Amsterdam, Ankara, LAPP Annecy, Argonne NL, Arizona, UT Arlington, Athens, NTU
Athens, Baku, IFAE Barcelona, Belgrade, Bergen, Berkeley LBL and UC, HU Berlin, Bern, Birmingham, UAN Bogota,
Bologna, Bonn, Boston, Brandeis, Brasil Cluster, Bratislava/SAS Kosice, Brookhaven NL, Buenos Aires, Bucharest,
Cambridge, Carleton, CERN, Chinese Cluster, Chicago, Chile, Clermont-Ferrand, Columbia, NBI Copenhagen,
Cosenza, AGH UST Cracow, IFJ PAN Cracow, UT Dallas, DESY, Dortmund, TU Dresden, JINR Dubna, Duke, Frascati,
Freiburg, Geneva, Genoa, Giessen, Glasgow, Göttingen, LPSC Grenoble, Technion Haifa, Hampton, Harvard,
Heidelberg, Hiroshima, Hiroshima IT, Indiana, Innsbruck, Iowa SU, Irvine UC, Istanbul Bogazici, KEK, Kobe, Kyoto,
Kyoto UE, Lancaster, UN La Plata, Lecce, Lisbon LIP, Liverpool, Ljubljana, QMW London, RHBNC London, UC
London, Lund, UA Madrid, Mainz, Manchester, CPPM Marseille, Massachusetts, MIT, Melbourne, Michigan,
Michigan SU, Milano, Minsk NAS, Minsk NCPHEP, Montreal, McGill Montreal, RUPHE Morocco, FIAN Moscow, ITEP
Moscow, MEPi Moscow, MSU Moscow, Munich LMU, MPI Munich, Nagasaki IAS, Nagoya, Naples, New Mexico,
New York, Nijmegen, BINP Novosibirsk, Ohio SU, Okayama, Oklahoma, Oklahoma SU, Olomouc, Oregon, LAL Orsay,
Osaka, Oslo, Oxford, Paris VI and VII, Pavia, Pennsylvania, Pisa, Pittsburgh, CAS Prague, CU Prague, TU Prague,
IHEP Protvino, Regina, Ritsumeikan, Rome I, Rome II, Rome III, Rutherford Appleton Laboratory, DAPNIA Saclay,
Santa Cruz UC, Sheffield, Shinshu, Siegen, Simon Fraser Burnaby, SLAC, Southern Methodist Dallas, NPI
Petersburg, Stockholm, KTH Stockholm, Stony Brook, Sydney, AS Taipei, Tbilisi, Tel Aviv, Thessaloniki, Tokyo ICEPP,
Tokyo MU, Toronto, TRIUMF, Tsukuba, Tufts, Udine/ICTP, Uppsala, Urbana UI, Valencia, UBC Vancouver, Victoria,
Washington, Weizmann Rehovot, FH Wiener Neustadt, Wisconsin, Wuppertal, Würzburg, Yale, Yerevan
LHC beams successfully circulated last year
Magnet failures demanded shutdown and repairs

ATLAS has collected millions of cosmics and is fully ready!!

**Latest LHC schedule:**
Nov. 19, 2009: startup beams
December: collisions, ramping from 900 to 7 TeV
February: start collecting ~50/pb at 7 TeV
June: start collecting ~250/pb at 8-10 TeV
Detector Operations / Commissioning

- **Pixel system**
  - Operations / Calibrations
  - Cosmic data analysis
- **Trigger / DAQ**
  - HLT Software
  - Physics triggers
  - CSC Readout
**Simulation**

**Pileup:** background from additional interactions

- Simulate minimum-bias pp collisions
- Simulate beam-halo and beam-gas
- Simulate cavern background (see next slide)
- Simulate physics event

Overlay events at Geant4 hit level

Include interactions from up to 36 bunch-crossings (~1 us) before/after

*Very CPU / memory intensive!*
Simulation

Cavern backgrounds: Low-energy photons and neutrons
- generated from interactions in walls/shielding

Affect detector lifetime and performance!

Create a tool for understanding cavern backgrounds in ATLAS
- Make comparisons to data - help troubleshoot shielding
- Study shielding requirements in planned upgrades

Neutron Flux

Center of ATLAS
Computing

275 Usable TB of disk
ZFS file system
servers run xrootd

600 cores, RHEL4, 2GB/core
Managed with LSF fairshares

OSG/ATLAS Grid environment

2x10Gb Ethernet to CERN

SLAC hosts the Western Tier2

SLAC could host additional Tier3 analysis capability:
**ATLAS Western Analysis Facility**

Andy Haas – SLUO DAY - 9/17/09
Reconstruction / Calibration

SLAC users are very active with jets
- Energy scale corrections
- Energy resolution
- Vertex associations
- b-tagging / triggers
- Missing ET

Close interaction with SLAC computing

Reduce impact of additional interactions
Physics and Analysis

Cooperating on physics themes:
- Top quark decays
- Tau channels
- Supersymmetry searches
- (New) long-lived particles

Cooperation with theorists at SLAC!
LHC Upgrade Schedule

Integrated Luminosity

- Phase 1
- Phase 2

2009: 0 fb⁻¹
2015: 700 fb⁻¹
2020: 5 ab⁻¹
Detector Upgrade R&D

Phase 1: Luminosity = \(3 \times 10^{34}\) (~75 pp interactions / crossing)
- Additional pixel layer at very small radius (IBL)
  - Lots of effort in many areas of IBL design and technology!
- Some trigger improvements

http://www.slac.stanford.edu/exp/atlas/upgrade/
Detector Upgrade R&D

Phase 2: Luminosity = $10^{35}$ (Up to 400 pp interactions / crossing!)

- New tracking system
  - LBNL / Santa Cruz / SLAC contributing to upgrade tracker simulation and design

- Major trigger / DAQ upgrades
  - LBNL investigating L1 track trigger

![Graph showing tracking efficiency vs. pileup events]

**Muons**

$\mu_T < 5$ GeV

![Diagram of detector components with annotations]

Support tube separating inner and outer

Outer detector by LBNL so far.

- 2nd doublet ~105 cm
- 1st doublet ~85 cm
Detector Upgrade R&D

Phase 2: Luminosity = $10^{35}$ (~400 pp interactions / crossing)
- Major trigger / DAQ upgrades
  - SLAC's “RCE” addresses various DAQ upgrade challenges

Entire LAr: 1524 FEB * 102.4 Gb/s > 150 Tb/s
- This bandwidth is the equivalent of streaming 40,000 uncompressed HDTV movies at once
CERN cannot host major portions of ATLAS long term
The Bay Area could act as a focal point for Western US ATLAS

This is just a vision at the moment!
Conclusions

LHC is the new energy frontier
  - First collisions expected in December
  - ATLAS is ready!

SLAC users are involved in many ATLAS activities:
  - Detector operations / commissioning
  - Simulation
  - Computing
  - Reconstruction / calibration
  - Physics and analysis
  - Detector upgrade R&D

SLAC could be part of a Bay Area focal point for Western US ATLAS