ATLAS SOFTWARE

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- IU Personnel Working on Software
- ATLAS SW Status
- Current and Future Work at IU

(Topics related to GRID will be covered in the next talk.)

Production Database Personnel

- John Callahan, Project Engineer
  - Design and implementation of the MS Access database used to track the TRT barrel production at IU.
- Eddie Morris, Production Engineer
  - Statistical Process Control (SPC) for quality assurance.
- Plarent Ymeri, Database Programmer
  - Inventory database, module passports, queries, reports.
  - Web interfaces for displaying information in the database.
- FL, Research Scientist
  - LabVIEW programs for automated testing and monitoring of the TRT barrel module production.
  - SQL connection between testing software and the database.

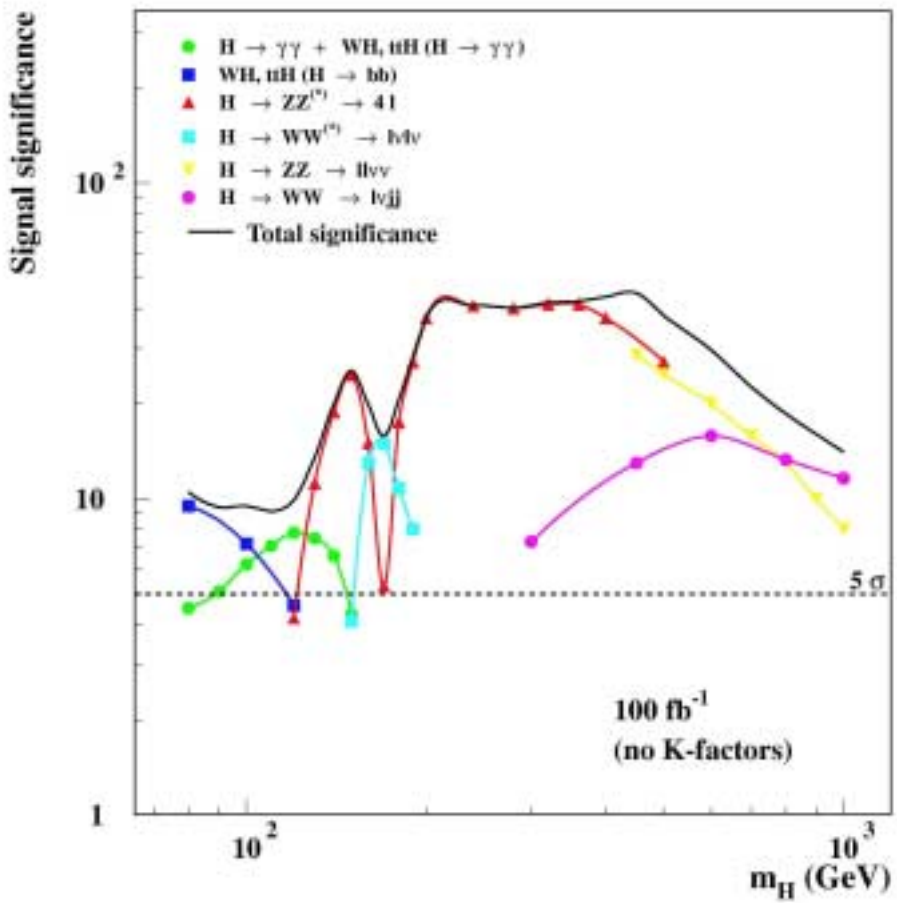
Offline SW Personnel

- Pauline Gagnon, Research Scientist
  - Working on track reconstruction interface to TRT digits.
  - Continuing work of Andrea Manara on Time over Threshold.
- Andrea Manara, Graduate Student
  - Thesis on Time over Threshold (graduated in October 2000).
- FL, Research Scientist
  - Member of ATLAS Architecture Review Committee.
  - TRT SW Coordinator, ID Simulation Coordinator.
  - Maintains the GEANT3 TRT simulation (geom. & digit.).
  - Pile-Up requirements and design for Athena.
- Thom Sulanke, System Administration
  - Supported entirely by university funds.
  - Shared with task D and E also.

ATLAS Offline Software

- ATLAS is in the process of converting its existing software from old-style procedural code (FORTRAN) to modern object-oriented code (C++ and Java).
- The FORTRAN software has been used to generate millions of Monte Carlo events for validating that the ATLAS detector design can measure the expected physics (e.g. the Higgs). Much of this work was done using:
  - The FORTRAN full detector simulation is known as ATLSIM.
  - The FORTRAN parametric simulation is known ATLFAST.
- The new object-oriented ATLAS offline framework is called Athena and will be used for simulation, reconstruction, and analysis.

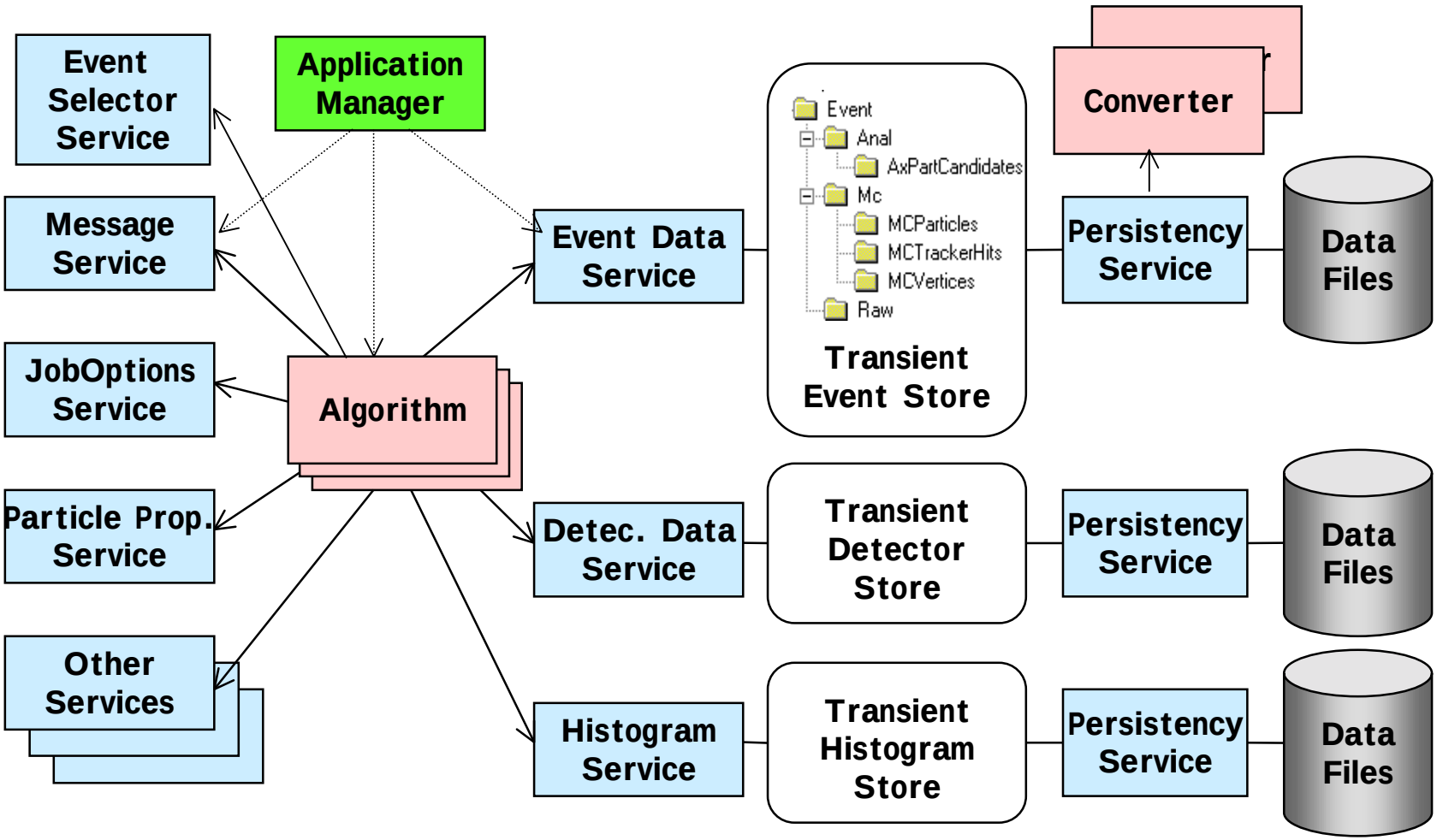
ATLAS Higgs Reach



Athena Architecture

- Some of the key features of Athena are:
  - Athena is based on the the GAUDI framework developed within LHCb and the kernel code development has become a cooperative effort between ATLAS and LHCb.
  - Athena (and Gaudi) maintain a strict separation of persistent data (i.e. files) and transient data (i.e. data in memory). This separation is useful because it allows the final choice of database to be deferred for more study and provides the possibility to change databases later.
  - Similarly Athena maintains a separation between data objects and algorithms. Example of a data objects are hits and found tracks while an example of an algorithm is a track finding routine.

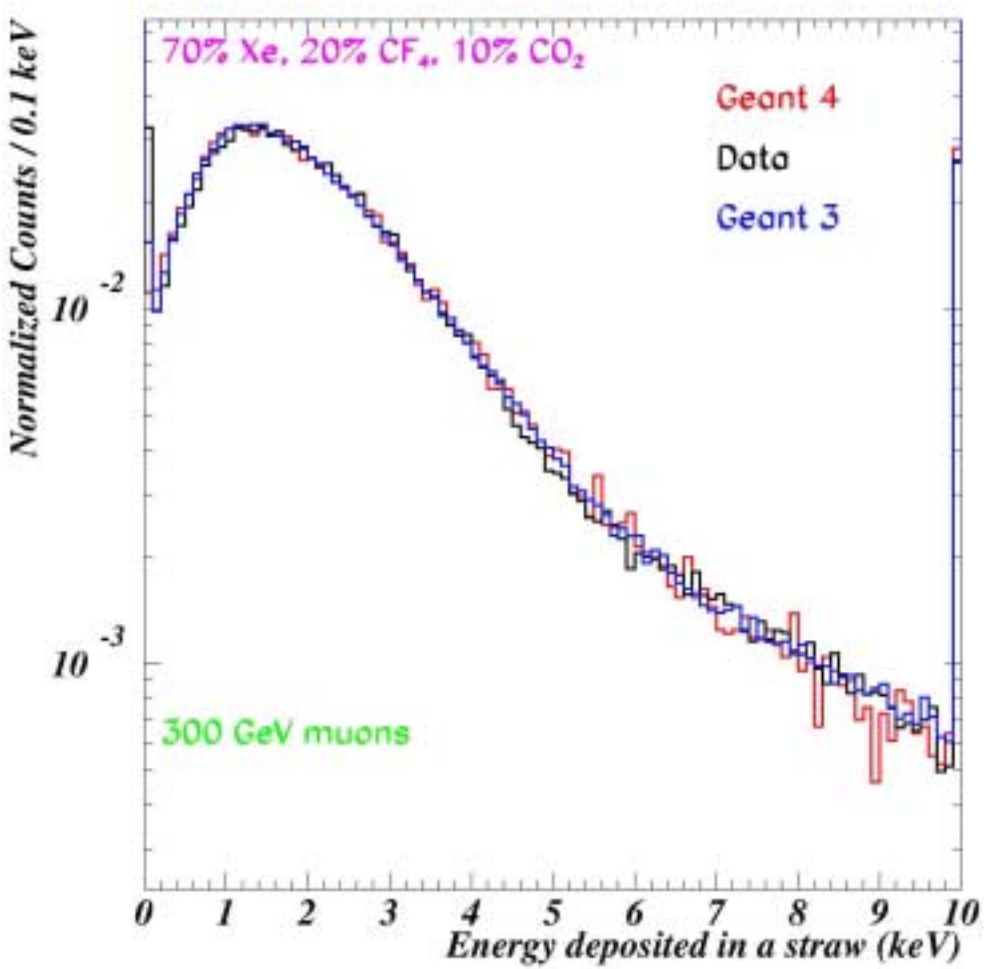
Athena / Gaudi Block Diagram



Critical Path Items for ATLAS SW

- The final choice of the database for the event store will be taken sometime in 2002. The choices are:
  - Objectivity (nominal baseline)
  - ROOT (fervent support in many quarters)
  - Oracle (not yet accepted officially as a possible choice)
- Work is also underway to convert the ATLAS detector simulation from GEANT3 to GEANT4.
  - Careful comparisons of data to the results produced by GEANT3 and GEANT4 have been made in the past two years and GEANT4 has been found to be working well.
  - Work is underway to describe the full ATLAS detector geometry in GEANT4 using XML statements.

GEANT3 and GEANT4 Comparison



K. Assamagan

Review of Atlas SW Architecture

- An comprehensive review of the ATLAS software architecture took place from July 2000 to March 2001. The final report was delivered in July 2002. Two questions were asked of the review team:
  - Is the ATLAS software headed in the correct direction?
  - If it is, will the software be delivered in a timely manner and do the jobs that ATLAS needs it to do?
- The outcome of the review was favorable and work continues on Athena.
- FL was a member of the review team and wrote sections of the report about simulation issues.

Architecture Review Outcome

- Some of the things that the review resulted in were:
  - Introduction of a data dictionary language to ease generation of the converters needed to put data into the database.
  - Revising Athena to make it more user friendly (e.g. a scripting language, dynamic object loading).
  - Recognition of a need to work out a clear plan of how GEANT4 will be used within the ATLAS software.
  - A much clearer overall picture of what milestones are required for the ATLAS software to be ready on time.
- The report made a total of 49 recommendations about the Athena design, selecting a database, the course of the simulation work, and the planning & milestones for the software work.

Data Challenges

- ATLAS is about to begin a series of Data Challenges to test the new software:
  - DC0 (Nov. 1, 2001 to Dec. 12, 2001) will process 100k events through reconstruction and analysis chain. The events will be generated with GEANT3.
  - DC1 (Feb. 1, 2002 to Jul. 31, 2002) will generate several 10^7 events for the ATLAS High Level Trigger TDR. DC1 will use about 1000 PCs spread over a number of sites. Several production periods totaling about 20 days are foreseen.
  - DC2 (Jan. 2003 to Sep. 2003) will generate about 10^8 events (the final scope depends on the results of DC0/1). GEANT4 will definitely be used to simulate the events.
- After DC1 is completed the ATLAS will write its Computing Technical Design Report (TDR).

Simulation Software Work by IU

- In the past year I worked on:
  - Maintaining and improving the GEANT3 simulation of the TRT. This includes finding and fixing bugs as well as changing the simulation to match the design of the TRT (the end-cap design is still being finalized.)
  - Redesigning the GEANT3 beampipe simulation to match the current beampipe design.
  - Monitoring the amount of material in the TRT particularly on the end of the TRT barrel. This is needed as an input to the simulation and reconstruction.
  - Simulating Time over Threshold (ToT) to identify electrons.
  - Assisting work on simulating the TRT readout bandwidth.
  - Producing a detailed design specification for implementing Pile-Up in the Athena framework.

Time over Threshold (ToT) Work

- A significant improvement in the ATLAS TRT particle identification capability at low energy is possible by using the width of the discriminator output to measure track energy deposition in the TRT straw gas volume.
- At low luminosity, the TRT readout will record the discriminator output state using 3.125 ns bins for the 75 ns following the trigger. This allows a reasonably precise measurement of the signal width.
- Andrea Manara (advisor Harold Ogren) received his thesis in October 2000:

  "Particle Identification using the Time-over-Threshold Method in the ATLAS Transition Radiation Tracker"

Software Coordination

- I have been involved in coordinating the software effort in a number of ways:
  - Coordinating the work of moving the simulation of the TRT from GEANT3 to GEANT4.
  - Coordinating the effort by the TRT group to prepare for the data challenges.
  - Giving talks to the TRT, Inner Detector, ATLAS Software, and GEANT4 communities on the status of the TRT software.
  - Recruiting and guiding new people in working on the software.
  - Serving on the Architecture review committee.

Next Year

- I will be heavily involved with the first two data challenges. This will include:
  - Coordination of work to simulate the TRT.
  - Testing that the code used for the data challenges operates correctly and debugging it when it does not.
  - Maintaining the GEANT3 code that will initially be used to generate the events. In particular as more is known about the TRT front-end electronics the simulation must be changed to reflect this.
- I will continue to work with the Athena design team to develop a workable pile-up strategy. A working pile-up algorithm is needed for DC1 so that the generated events can be used for the Trigger TDR.

Next Year (Continued)

- Pauline Gagnon will continue of the Time over Threshold Studies begun by Andrea Manara:
  - Make the changes needed to allow the Time over Threshold analysis to run within Athena. This includes interfacing digitizations to the reconstruction code.
  - Continue to study the improvement that the analysis makes in the e/π separation using the previously developed likelihood method.
  - Investigate variations of this method for kaon identification.
  - Possibly look at the use of neural networks to improve the identification power.