

# ATLAS Subsystem Software

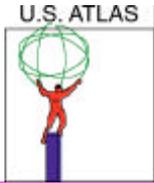
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- **US active in all subsystems:**

- u **Silicon, Transition Radiation Tracker, Liquid Argon, Tile Calorimeter, Muon.**

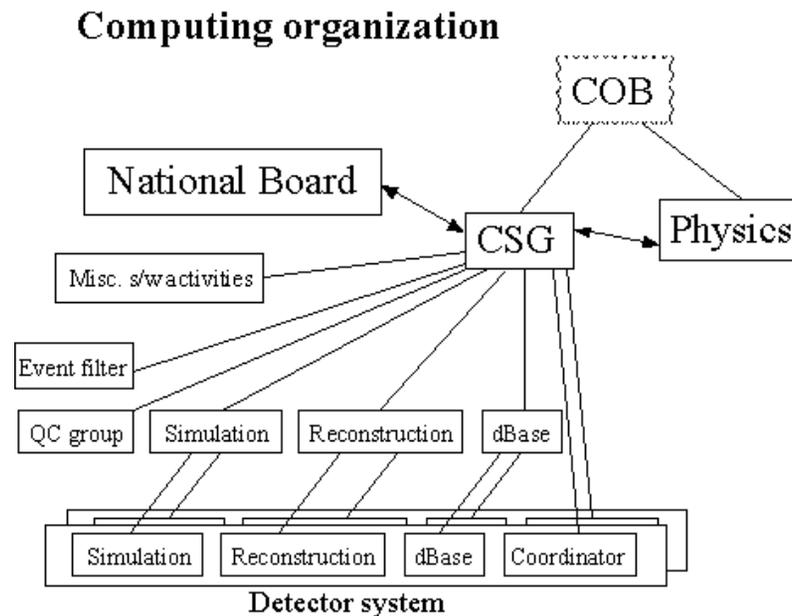
- **Reported by J. Shank, work by many US collaborators as gathered by the US subsystem contacts(in subsystem order):**

- **L. Vacavant, K. Baker, S. Rajagopalan, F. Merrit, B. Zhou**



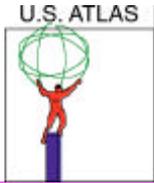
# CERN Computing Org. Chart

- **Proposed (N. McCubbin):**



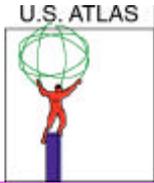
- **...still under discussion.**

u **But clearly a strong emphasis on subsystems**



# ATLAS Computing organization

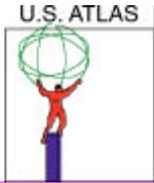
	Offline Coordinator	Reconstruction	Simulation	Database
<b>Chair</b>	N. McCubbin	D. Rousseau	A. Dell'Acqua	<b>D.Malon</b> / RD Schaffer
<b>Inner Detector</b>	D. Barberis	D. Rousseau	<b>F. Luehring</b>	J. Pater
<b>Liquid Argon</b>	J. Collot	J. Schwindling	<b>M. Leltchouk</b>	S. Simion
<b>Tile calorimeter</b>	A. Solodkov	<b>F. Merritt</b>	A. Solodkov	<b>T. LeCompte</b>
<b>Muon</b>	G. Poulard	J.F. Laporte	A. Rimoldi	<b>S. Goldfarb</b>
<b>LVL2 trigger</b>		S. Tapprogge		
<b>Trigger/DAQ</b>	S. George		T. Hansl- Kozanecki	H.P. Beck
<b>Event Filter</b>	V. Vercesi	F. Touchard		



# The Common Elements

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- **Detector Description**
  - u **DB**  $\Leftrightarrow$  **XML**  $\Leftrightarrow$  **Generic Model**
- **GEANT4 Simulation**
- **Reconstruction**



# Si Tracker Software

Current activities in the US:

- **Pixel Test-Beam Simulation with Geant4 [LBNL, L.Vacavant]**
  - u redesign of the software (OO)
  - u validation of G4
- **Visualization for the reconstruction [UC Santa Cruz, A.Litke]**
  - u involved in the development of ATLANTIS (based on ALEPH's DALI)
  - u main goal is to check the pattern recognition in the tracker
- **Activities with old legacy software [LBNL, L.Vacavant]**
  - u No real development activity, some specific studies
  - u geometrical acceptance of the pixel endcap layout
  - u impact of misalignment of the pixel disks

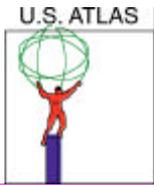


# G4 Pixel test beam simulation

- **Goals:**

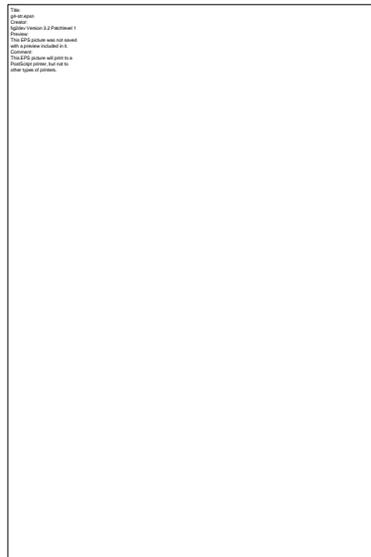
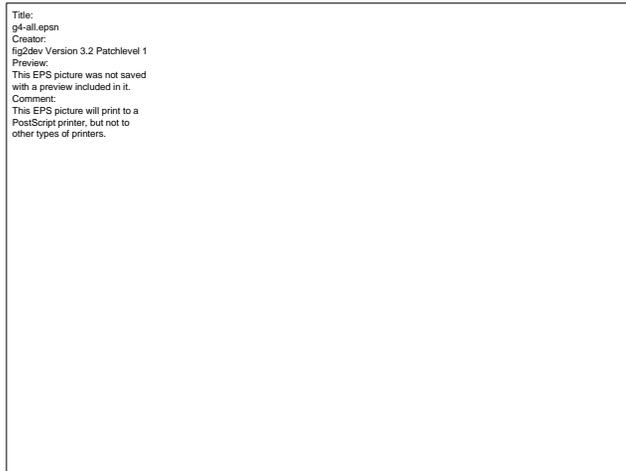
- u **To gather experience with OO (new paradigm for most of us) and with GEANT4 + validate G4**
  - s **The physics part of G4 is very different from GEANT3. The test-beam simulation project allows us to:**
    - **cross-check G4 vs G3**
    - **cross-check G4 vs Data**
- u **Test-bed for the ATLAS Pixel System**

The following parts are currently being developed within the test-beam simulation project and will be **re-used** directly for the whole pixel system: pixel module geometry, user-defined material management and physics interactions, user-defined tracking and stepping related classes, digitization, infrastructure (histogramming, visualization, GUI).

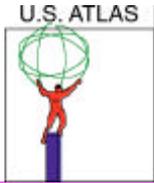


# G4 Pixel test beam simulation

- **Status: Current version (0.2) features:**
  - u **As complete as the G3 simulation**
  - u **Design allows easy reconfiguration**
    - s **STL collection of TelescopeElements (insertable, reposition anywhere)**



BNL review, 10-11 January, 2000



# G4 Pixel test beam simulation

- **Development framework**

- u **For testing, the C++ digitization is being developed independently of G4 and can be run in 3 modes:**
  - s **Stand-alone for quick checks. Reads in ASCII file of hits.**
  - s **Within ATLSIM for checks against the “old” digitization**
  - s **Within GEANT4**

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fig2dev Version 3.2 Patchlevel 1  
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# Si Visualization

- **Status**

- u **UCSC joined the effort to develop ATLANTIS**
- u **Working on ID display to check pattern recognition**

- **Short term plan:**

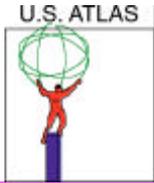
- u **Interface to read existing simulated events**
- u **Use to compare existing tracking packages**
- u **Work on conversion to OO**

U.S. ATLAS



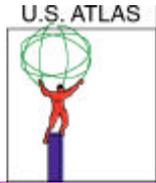
# Si Event Display

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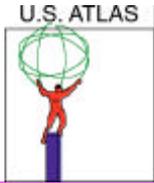
## Future Activities in Si

- Pixel testbeam simulation
- Refinements of pixel G4 description
  - u Emphasizing correct simulation of the pixel modules
- Design evolution  $\Rightarrow$  whole pixel simulation
  - u Integration in the ATLAS framework
  - u Database/detector description
- Coordinate with similar efforts for SCT
- Work on visualization with ATLANTIS



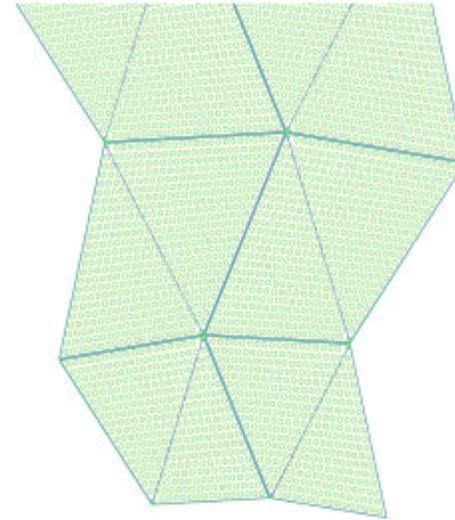
# TRT Software

- **Many GEANT3 studies:**
  - u **material budgets**
  - u **Pile-up studies**
  - u **Results in several ATLAS notes and TDRs**
- **Testbeam software**
  - u **Comparing G3 with data**
    - s **No TR in G3-added by ATLAS**
- **Physics simulations**
  - u **With ATLAS fast MC, ATLFAST**
    - s **Results in Physics TDR, ATLAS notes.**
      - **SUSY Higgs, e.g.**



# TRT GEANT3 WORK

**TRT Barrel Modules  
Fully Simulated**



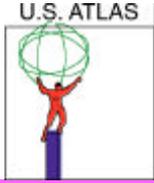
- **TRT SW Liaison Work:**
  - u **Included TRT barrel modules**
  - u **Careful tuning of material**
  - u **Improved straw response and electronics model**
  - u **A fair number of bug fixes**
- **Fake rate and track finding efficiency studies for the Physics TDR.**



## Future TRT effort

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- **G3  $\Rightarrow$  G4 starting with testbeam**
- **Improve  $e$ - $\pi$  separation with neural nets**
- **Design of the TRT data event model**
- **Define transient  $\Leftrightarrow$  persistent mapping**



# Liquid Argon Software

- **Simulation**

- u **GEANT3 in the Physics TDR**

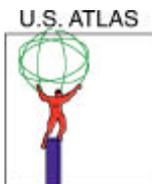
- s **Optimization of strip width based on  $\pi^0$  rejection and pointing studies**
    - s **Optimal depth and granularity of each of 3 samplings for different Pb thickness**
    - s **Simulation of dead material in front of the Cal.**

- **DB/Detector description**

- **Test beam**

- **Calibration**

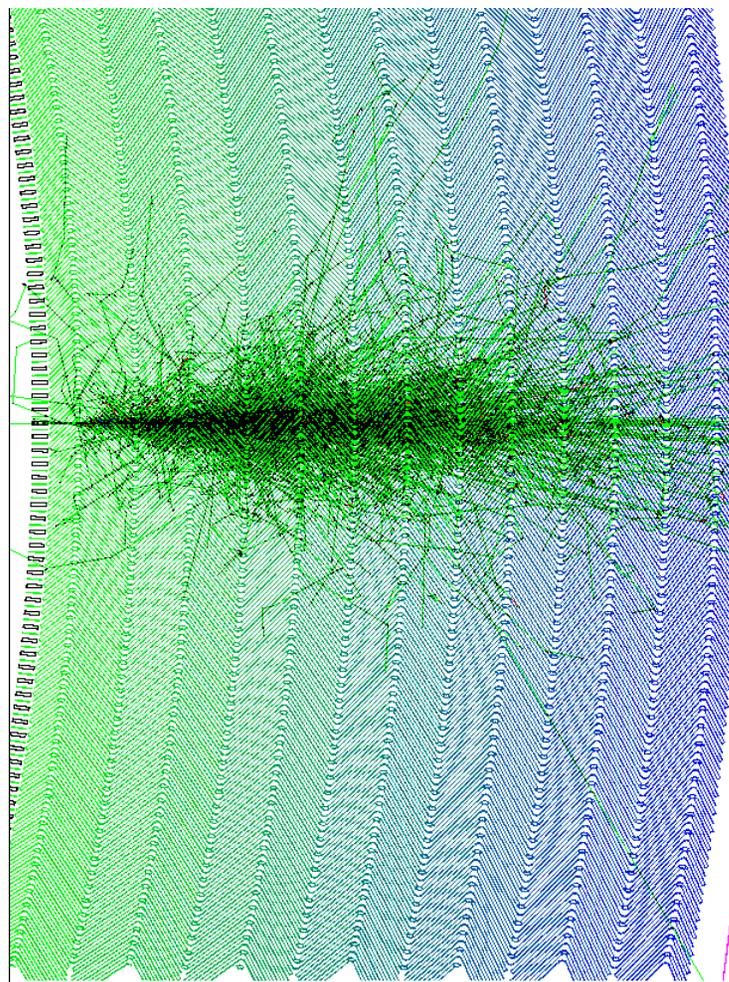
- **Detector response and physics studies**



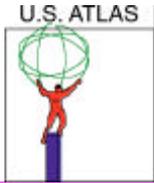
# Liquid Argon Simulation in G4

- Struggling with the accordion geometry in G4
  - u no appropriate shape
- Large memory usage vs long tracking time

10 GeV shower  $\Rightarrow$



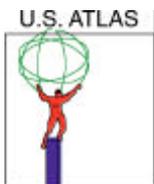
BNL review, 10-11 January, 2000



# LAr Reconstruction (OO)

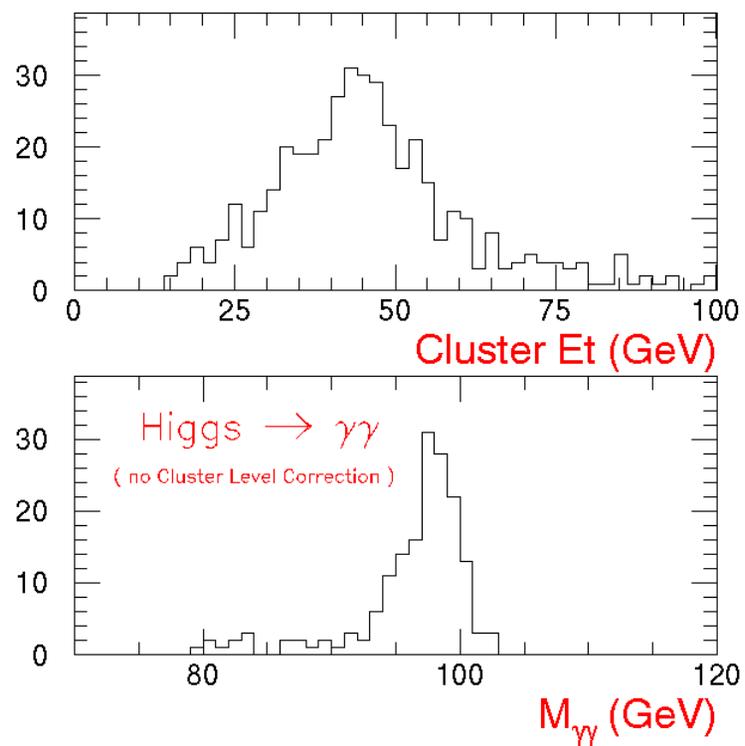
- **USDP:**

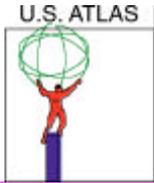
- u Use cases have been developed
- u Prototype designed with UML
- u First implementation in PASO (Provisional Analysis Skeleton for Object oriented software)
- u Reads data from the old GEANT3 simulation
- u Implements basic cell and cluster finding algorithms and outputs the following:



# LAr Reconstruction (OO)

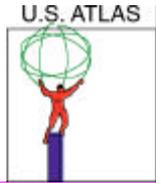
LAr Reconstruction, OO Design in Paso





# TileCal (Hadron Calorimetry)

- **Tilecal Pilot Project: test-beam analysis system using OO/C++ and Objectivity, developed by U.S. groups, providing:**
  - u **OO logical model of Tilecal.**
  - u **Detector-centric data access architecture.**
  - u **Full access to 1998-1999 Tilecal test-beam data.**
  - u **Support for custom calibration strategies.**
- **Present system has full functionality of old Fortran analysis system.**
  - u **All initial Pilot Project goals have been met.**
  - u **Tutorial was presented at CERN in Nov 99, with examples and online documentation.**



# TileCal (Hadron Calorimetry)

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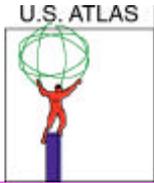
- **Future Pilot Project development:**
  - u **Optimal filtering (needed for good resolution at high luminosity operation).**
  - u **Improvements in structure of code and classes.**
  - u **Improvements in documentation and user interface.**
  - u **Added functionality and new analysis tools (e.g., LHC<sup>++</sup>)**
- **Note: The Pilot Project is a testbed for code development as well as a tool for online data analysis. This dual purpose is an essential feature of the project, providing feedback from users to developers regarding actual usage of the software.**



# TileCal (Hadron Calorimetry)

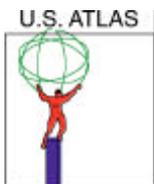
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- **PASO (Provisional Analysis Skeleton in OO)**
  - u This is an off-line analysis framework for the development of OO analysis, able to read Geant3 tapes generated for TDR studies.
  - u Tilecal work with PASO has begun with development of transient data record for “full ATLAS” Tilecal system.
  - u Will be able to read Geant3 tapes by Feb 2000.
  - u Development of cluster-finding techniques during spring 2000.



# TileCal (Hadron Calorimetry)

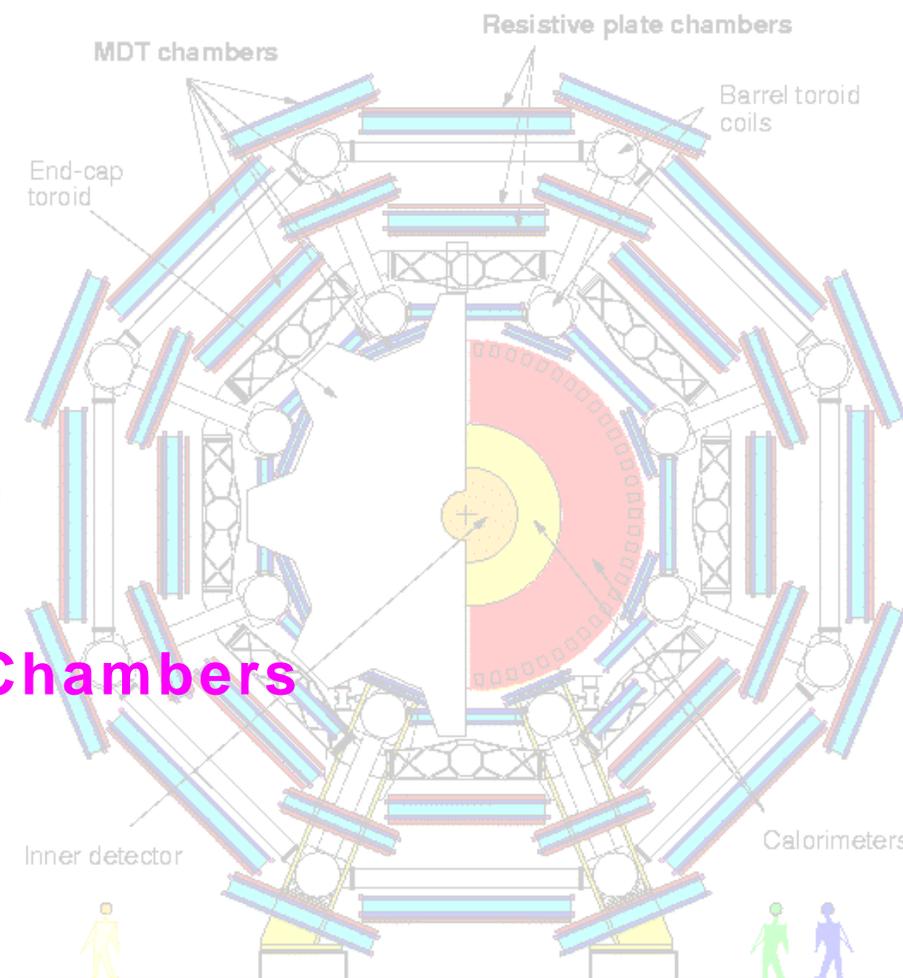
- Work well underway on development of Tilecal detector description using XML (essential for Geant4).
- Discussions underway with LAr group concerning:
  - u Common data structures for Tilecal and LAr.
  - u Common or parallel code structure for cluster-finding.
  - u Combined effort on jet reconstruction and energy resolution.
  - u To be discussed: combining LAr and Tilecal energies at the cell/tower level, before cluster-finding is carried out.



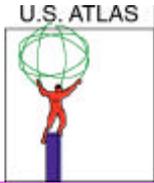
# Muon Software

- Areas of US involvement:

- u DB
- u Simulation
- u Reconstruction
- u Trigger
- u Cathode Strip Chambers



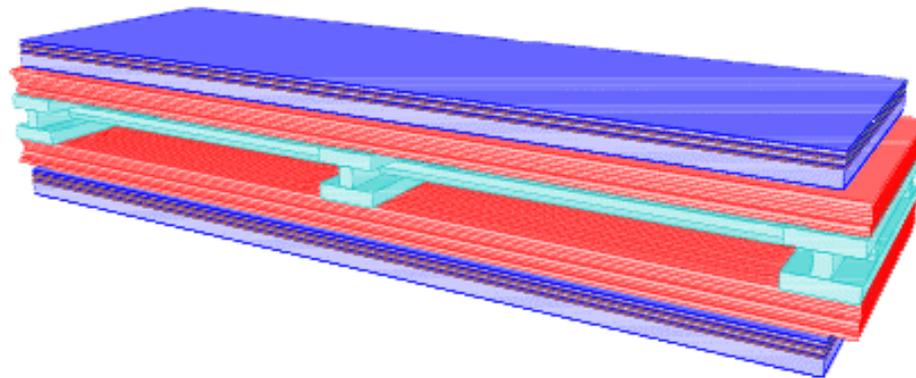
BNL review, 10-11 January, 2000



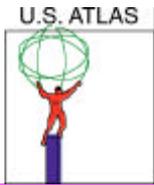
# Muon DB/Detector description

- A BMS1 Barrel Station in XML:

```
<composition name="MU_BMS1_Station">  
  <posXYZ volume="MU_BMS1_UpperRPC" X_Y_Z="0 251.96 0" index="0 1 0"/>  
  <posXYZ volume="MU_BMS1_UpperMDT" X_Y_Z="0 133.48 0" index="0 1 0"/>  
  <posXYZ volume="MU_BMS1_Spacer" X_Y_Z="0 0 0" />  
  <posXYZ volume="MU_BMS1_LowerMDT" X_Y_Z="0 -133.48 0" index="0 0 0"/>  
  <posXYZ volume="MU_BMS1_LowerRPC" X_Y_Z="0 -251.96 0" index="0 0 0"/>  
</composition>
```

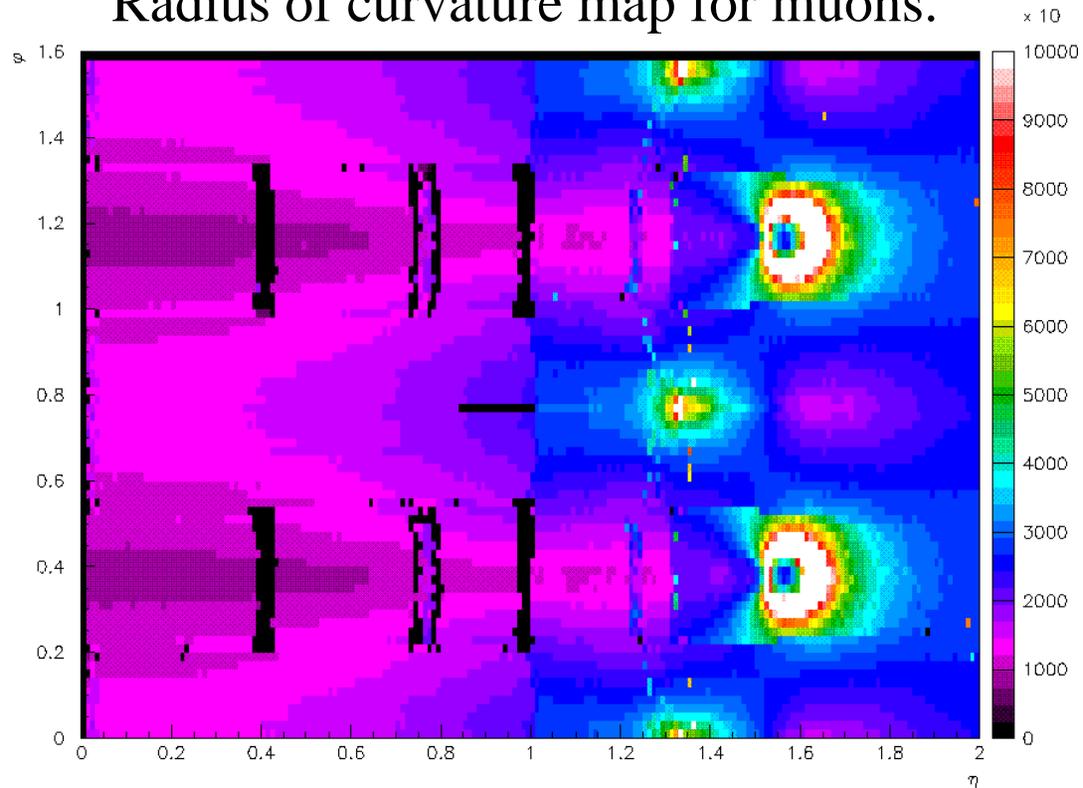


See Goldfarb's web site for full details: <http://home.cern.ch/muondoc/software/Database/>



# Muon Level 2 Trigger

Radius of curvature map for muons.





# Muon Level 2 Trigger

Level 2 momentum resolution for 20 Gev muons.

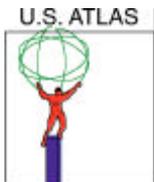
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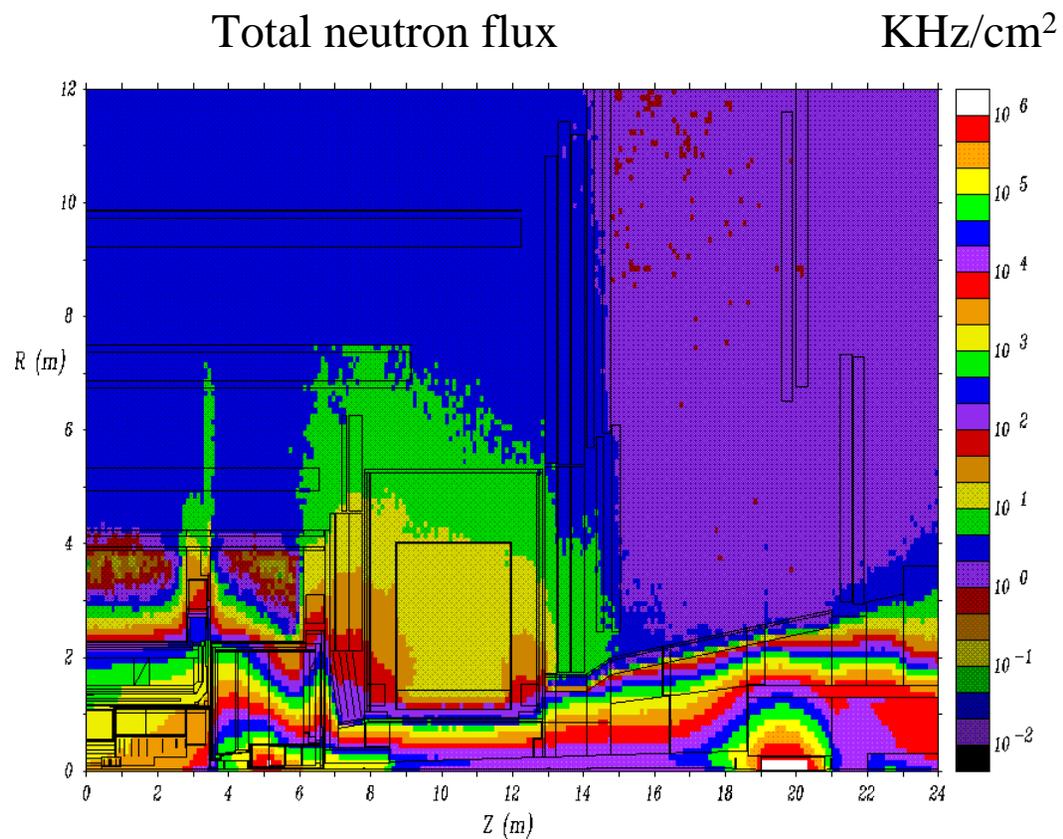
# Cathode Strip Chambers

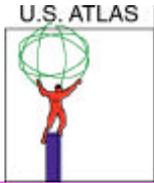
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(coming from Nevski...)



# Neutron Background Studies





# Conclusions

- **Broad range of activities, well integrated in the whole of ATLAS**
- **Leadership roles in many areas**
- **Well positioned for future software agreements**
  - u **(we expect subsystem MOU's to be later than core software MOU's)**