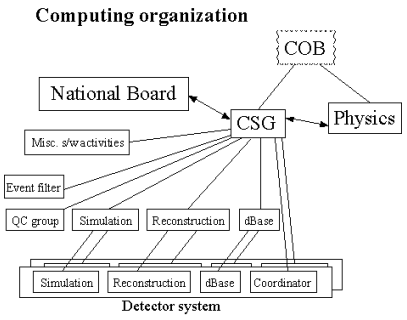
ATLAS Subsystem Software

- **US active in all subsystems:**
  - **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.**
  - **But clearly a strong emphasis on subsystems**

ATLAS Computing organization

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

The Common Elements

- **Detector Description**
  - **DB ⇔XML ⇔ Generic Model**
- **GEANT4 Simulation**
- **Reconstruction**

Si Tracker Software

Current activities in the US:

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

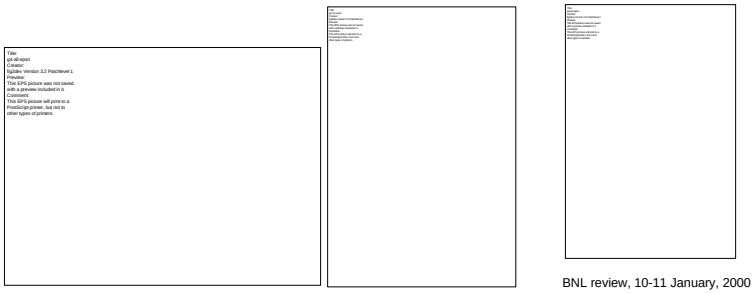
G4 Pixel test beam simulation

- **Goals:**
  - **To gather experience with OO (new paradigm for most of us) and with GEANT4 + validate G4**
    - **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**
  - **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:**
  - **As complete as the G3 simulation**
  - **Design allows easy reconfiguration**
    - **STL collection of TelescopeElements (insertable, reposition anywhere)**



G4 Pixel test beam simulation

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

Si Visualization

- **Status**
  - UCSC joined the effort to develop ATLANTIS
  - Working on ID display to check pattern recognition
- **Short term plan:**
  - Interface to read existing simulated events
  - Use to compare existing tracking packages
  - Work on conversion to OO

Si Event Display

Future Activities in Si

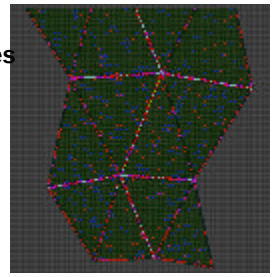
- Pixel testbeam simulation
- Refinements of pixel G4 description
  - Emphasizing correct simulation of the pixel modules
- Design evolution ⇒whole pixel simulation
  - Integration in the ATLAS framework
  - Database/detector description
- Coordinate with similar efforts for SCT
- Work on visualization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

TRT Software

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

TRT GEANT3 WORK

TRT Barrel Modules
Fully Simulated



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

Future TRT effort

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

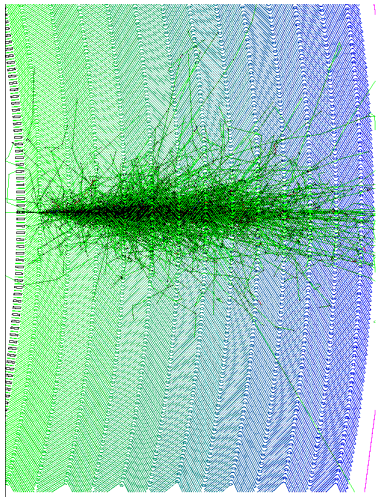
Liquid Argon Software

- Simulation
  - GEANT3 in the Physics TDR
    - Optimization of strip width based on π^0 rejection and pointing studies
    - Optimal depth and granularity of each of 3 samplings for different Pb thickness
    - 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
  - no appropriate shape
- Large memory usage vs long tracking time

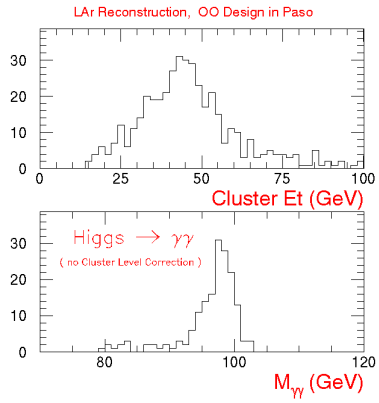
10 GeV shower ⇒



LAr Reconstruction (OO)

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

LAr Reconstruction (OO)



TileCal (Hadron Calorimetry)

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

TileCal (Hadron Calorimetry)

- Future Pilot Project development:
  - Optimal filtering (needed for good resolution at high luminosity operation).
  - Improvements in structure of code and classes.
  - Improvements in documentation and user interface.
  - Added functionality and new analysis tools (e.g., LHC^{++})
- 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)

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

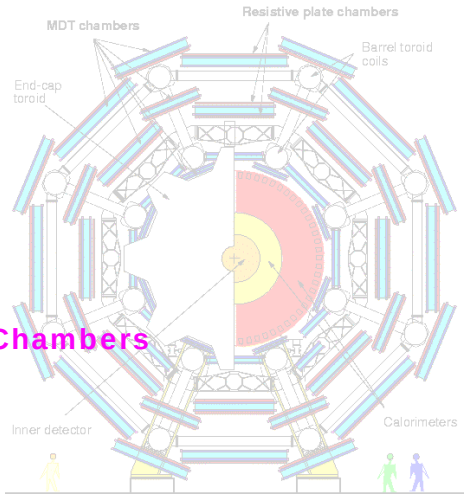
TileCal (Hadron Calorimetry)

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

BNL review, 10-11 January, 2000

Muon Software

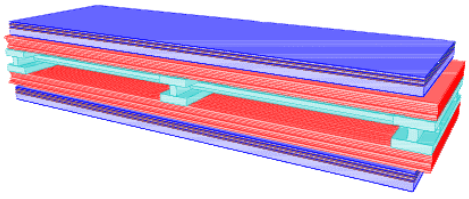
- **Areas of US involvement:**
  - **DB**
  - **Simulation**
  - **Reconstruction**
  - **Trigger**
  - **Cathode Strip Chambers**



Muon DB/Detector description

- **A BMS1 Barrel Station in XML:**

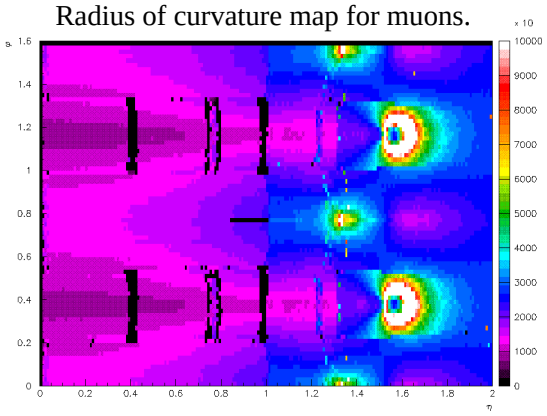
```
<composition name="MU_BMS1_Station">
   <posXYZ volume="MU_BMS1_UpperRPC" X_Y_Z="0  251.96  0" index="0 1 0"/>
   <posXYZ volume="MU_BMS1_UpperMDT" X_Y_Z="0  133.48  0" index="0 1 0"/>
   <posXYZ volume="MU_BMS1_Spacer"   X_Y_Z="0    0     0" />
   <posXYZ volume="MU_BMS1_LowerMDT" X_Y_Z="0 -133.48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

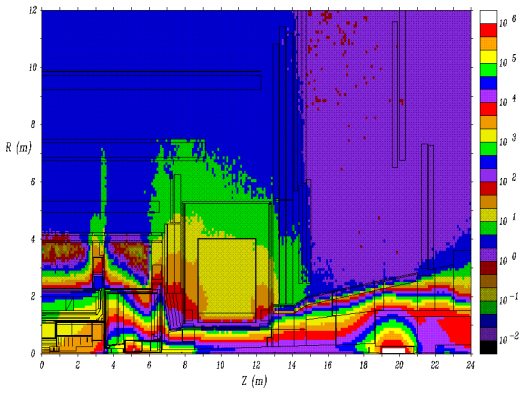
Level 2 momentum resolution for 20 Gev muons.

Cathode Strip Chambers

(coming from Nevski…)

Neutron Background Studies

Total neutron flux KHz/cm^2



Conclusions

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