

TRIUMF G4 Participants

- ♦ P. Gumplinger - Group coordinator / TSB
(optical photon physics / overall G4 architecture)
- ♦ G. Greeniaus
(low energy hadronic interactions)
- ♦ Fred Jones
(s/w release management, testing, coding)
- ♦ Joe Chuma
(documentation, coding)

Participation in the following G4 working groups:

Hadronic Physics, Electromagnetic Physics, Testing and Quality Assurance, Documentation Management.

- ♦ M. Losty - CB
(ATLAS/HEC G4 physics validation project)

University of Montreal/TRIUMF

[R. Mazini, G. Azuelos, P. Gumplinger]

- **Test Beam Setup** (test beam line, LAr cryostat, wire chambers, muon catcher)
- **HEC and FCAL** (geometry representation including all G3 features of the calorimeter)
- **Comparison with 1998 test beam data**

FCAL study done in close collaboration with P. Loch/University of Arizona

HEC study is being done in communication with MPI-Munich

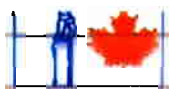
R. Mazini has now also joined the GEANT4 Collaboration



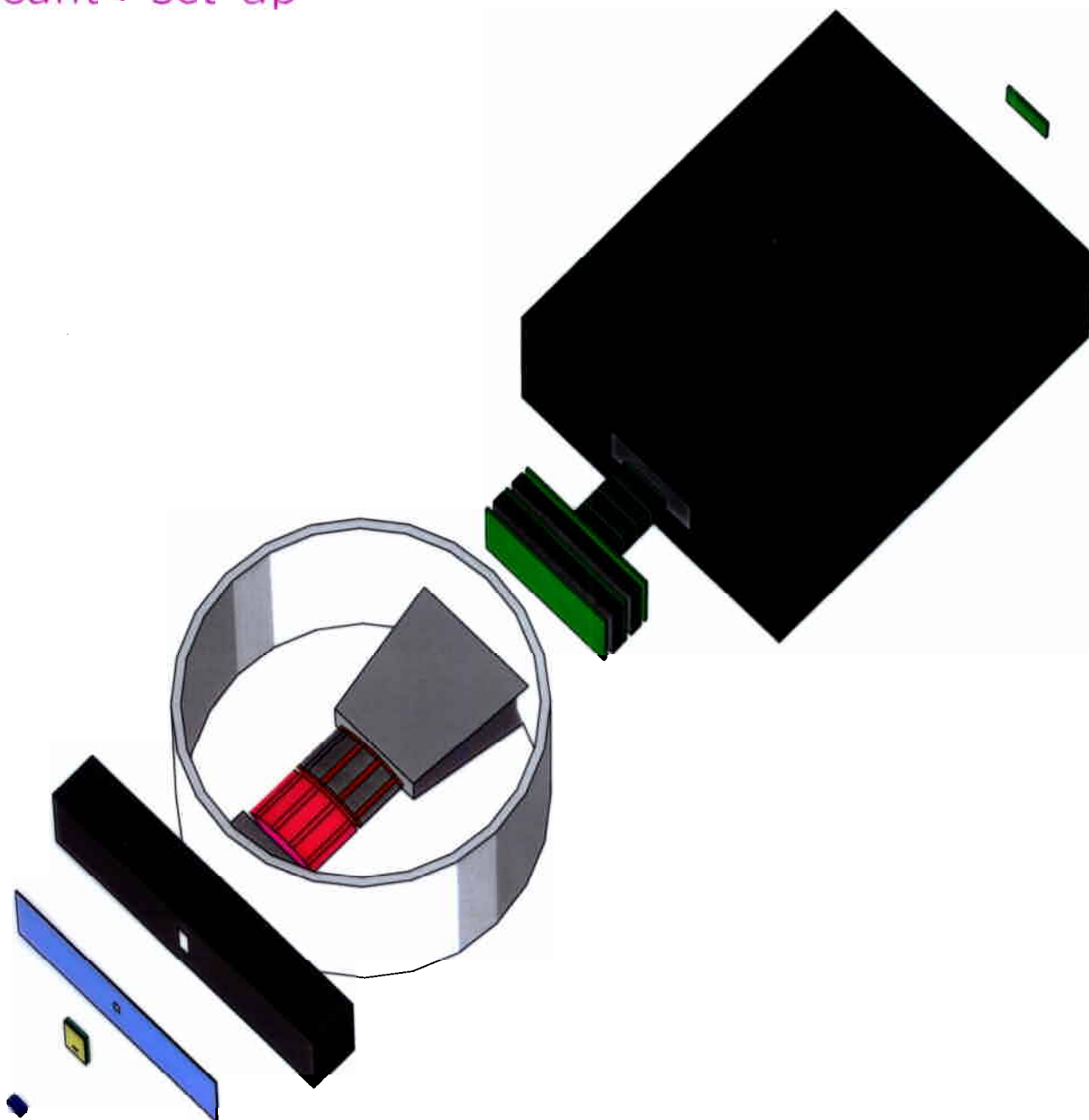
Rachid Mazini
Université de Montréal
Peter Loch
University of Arizona

Comparison of Experimental Electron Signals with GEANT3 and GEANT4 Simulations for the ATLAS Forward Calorimeter Prototype

- FCal Module U's
- Monte Carlo set up with Geant4
- Results
 - Energy Resolution
 - Linearity
 - Signal profile
- conclusions and Outlook

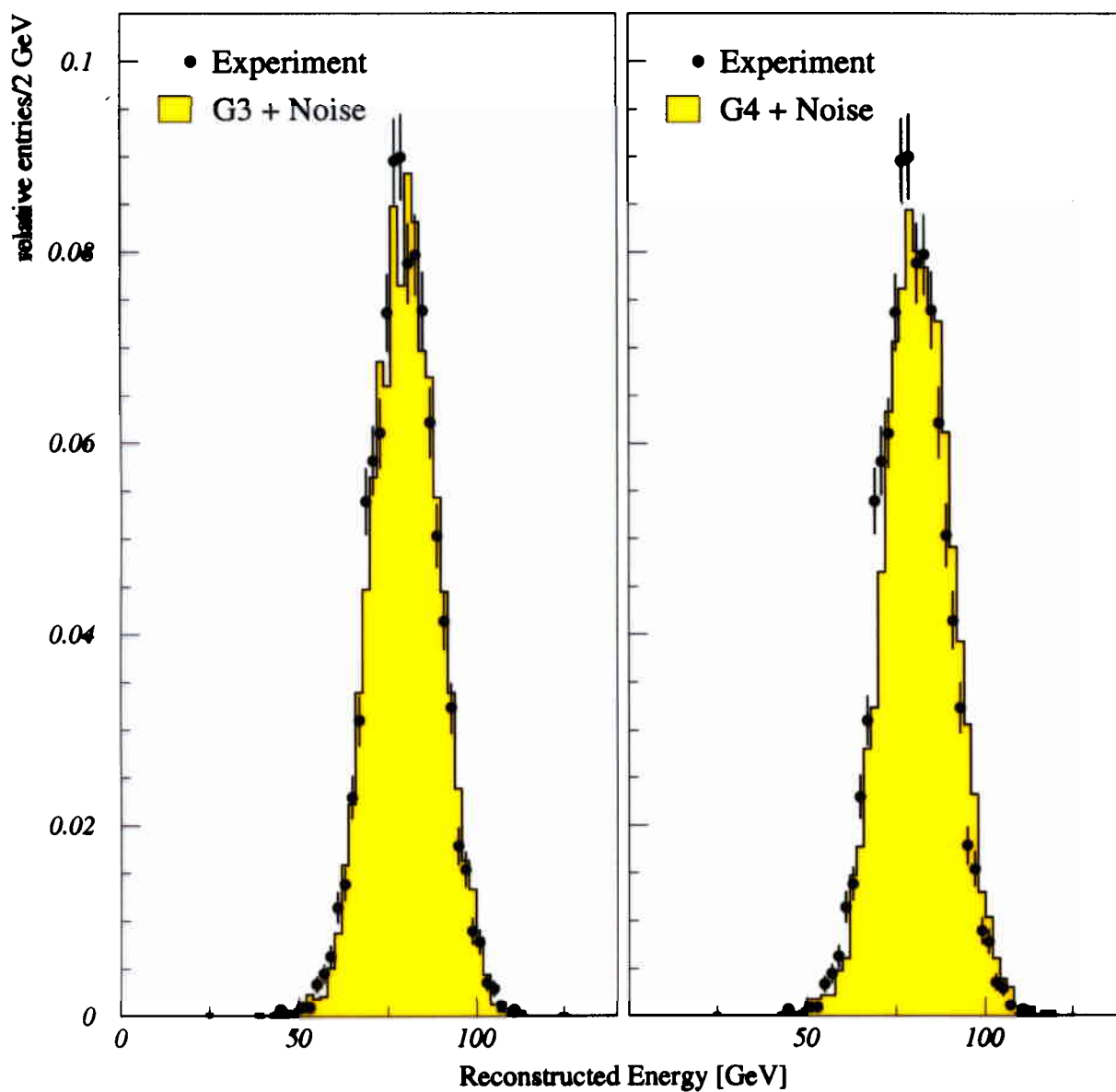


Geant4 set up



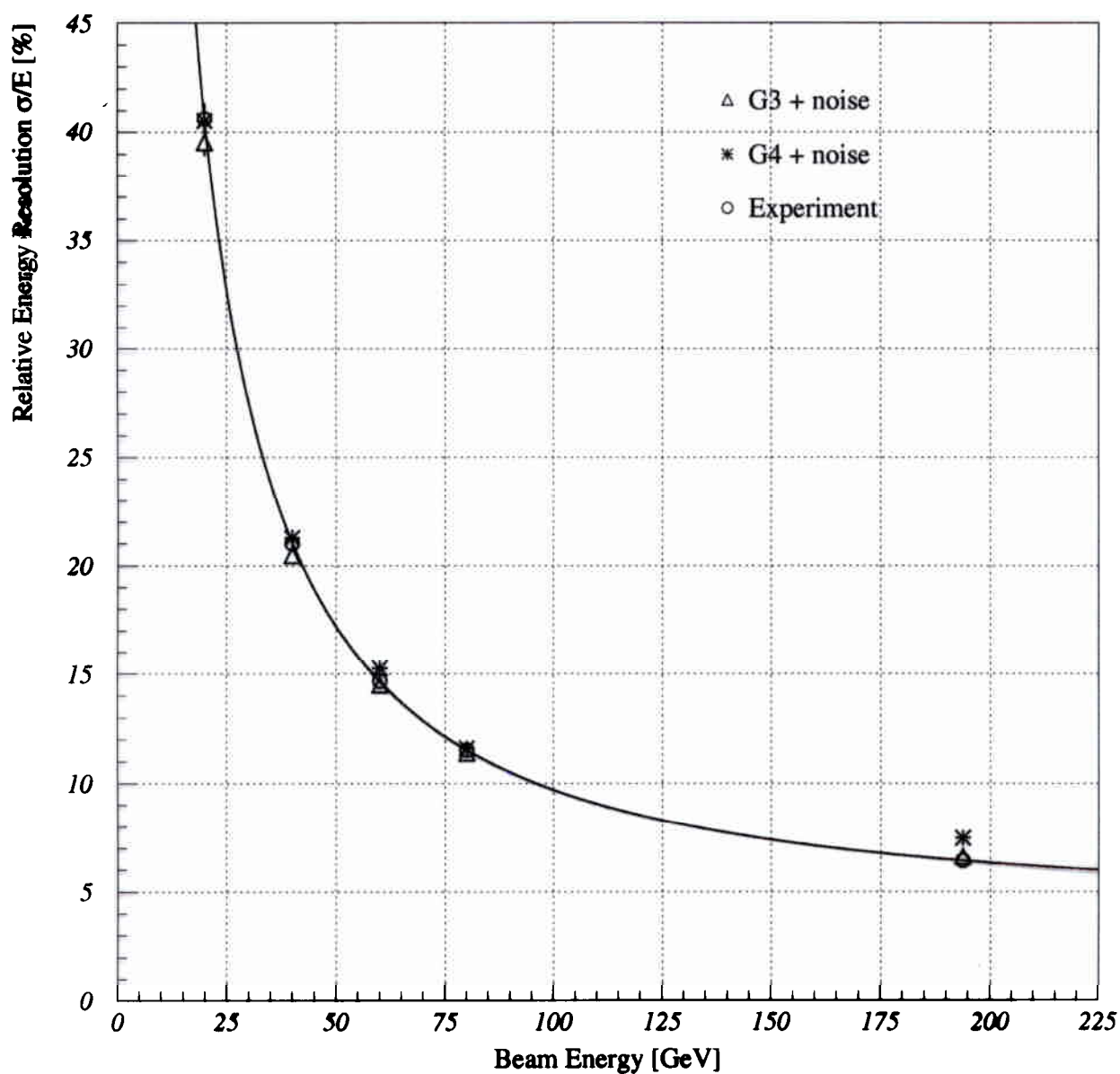


80 GeV Electron Signal Distributions





FCal1 Electron Energy Resolution

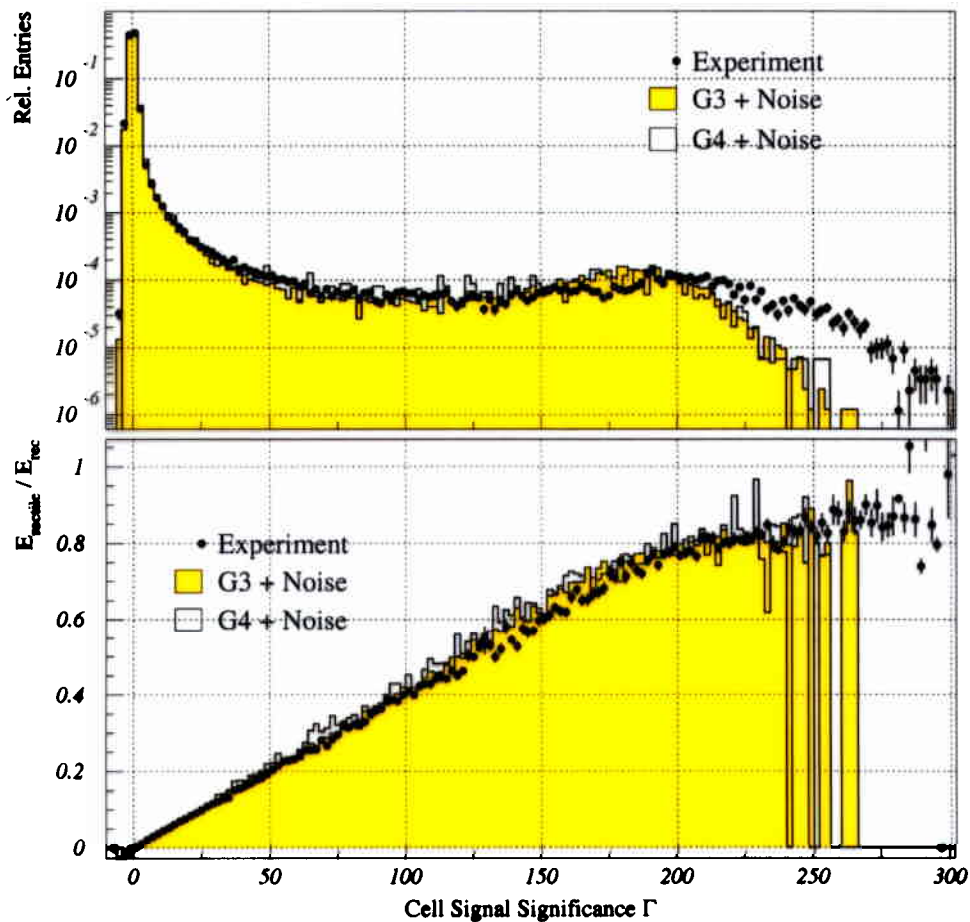


No noise cut, no cylinder cut.

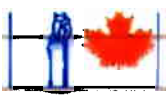


Detailed Look at Signal Composition

$$\Gamma = \frac{E_{rec}^{tile}}{EN E_{tile}^{tile}}$$



More highly significant signals in experiment than in both Geant3 and Geant4 Geometry effect, softer shower in MC.



Conclusion and Outlook

- comparison of Geant3 and Geant4 for FCAL1 Module 0 shows a good agreement for both signal and energy resolution.
- adding noise to simulated data at cell level produces a rather good agreement between data and Monte Carlo for global; energy sums and resolution, at the level of (few) percent;
- Secondary tracks produced with a low range cut should be investigated. Possible problem with 0.005mm cut!
- detailed comparisons of shower developpemet show some problems for both Geant3 and Geant4
- more studies are done to understand the signal significance: geometry effects (FCAL angle, experimental data misalignement), shower more soft in MC...
- Geant4 compares relatively well to the experimental data and is much faster;
- Hadrons study are the next challenge!

University of Toronto

[D. Bailey]

- FCAL (hadronic features of GEANT4)
- Three reports at ATLAS G4 validation meetings.
- First feedback (problem report) to G4 collaboration and TRIUMF authors of the GHEISHA redesign and C++ conversion for G4.

University of Montreal/TRIUMF

[D. Cote-Ahern, P. Gumplinger, P. Depommier]

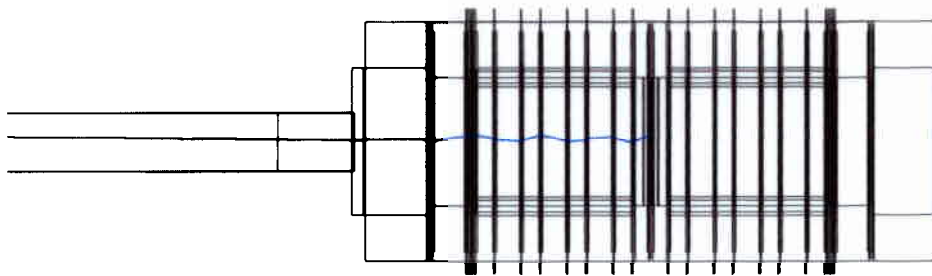
- GEANT4 Spin Tracking in magnetic field according to the Bargmann-Michel-Telegdi Equation
- under grad. Student thesis
- integral part of G4 (was available in G3 only as a user modification)
- benefits TRIUMF E614/TWIST collaboration

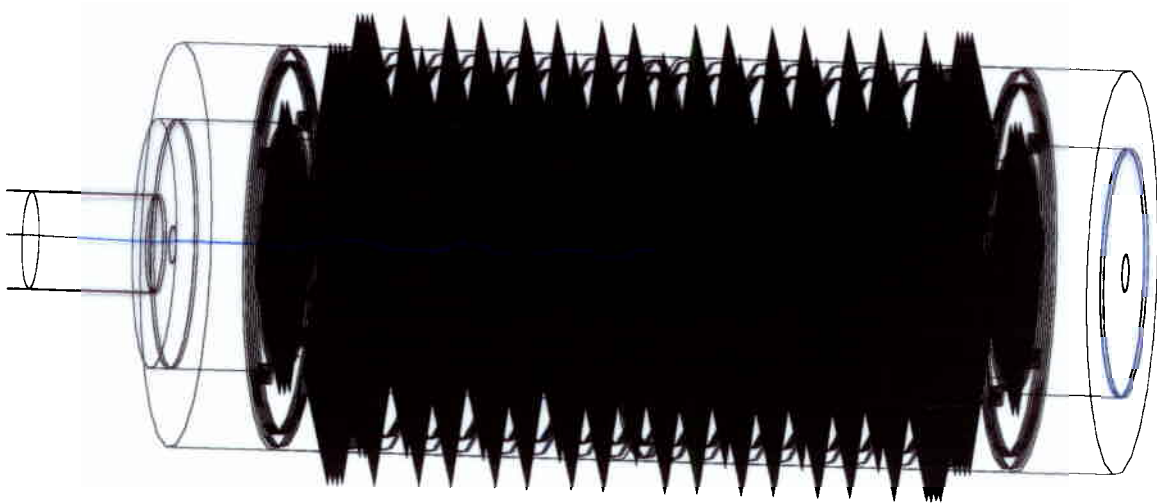
TRIUMF E614/TWIST

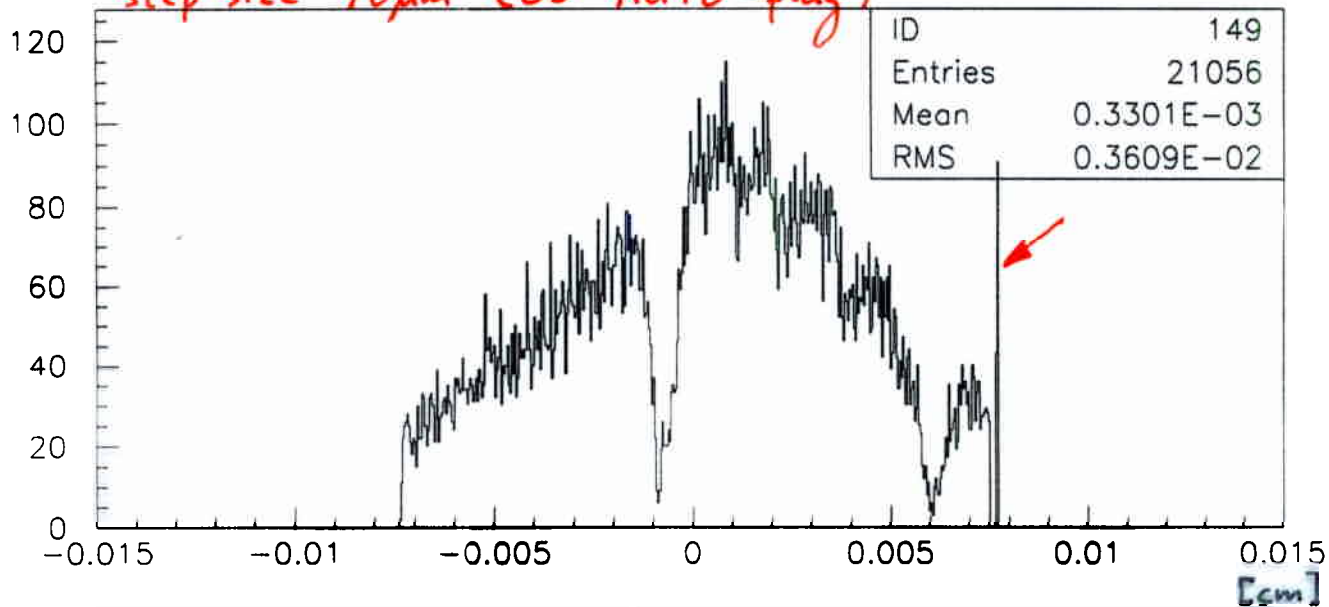
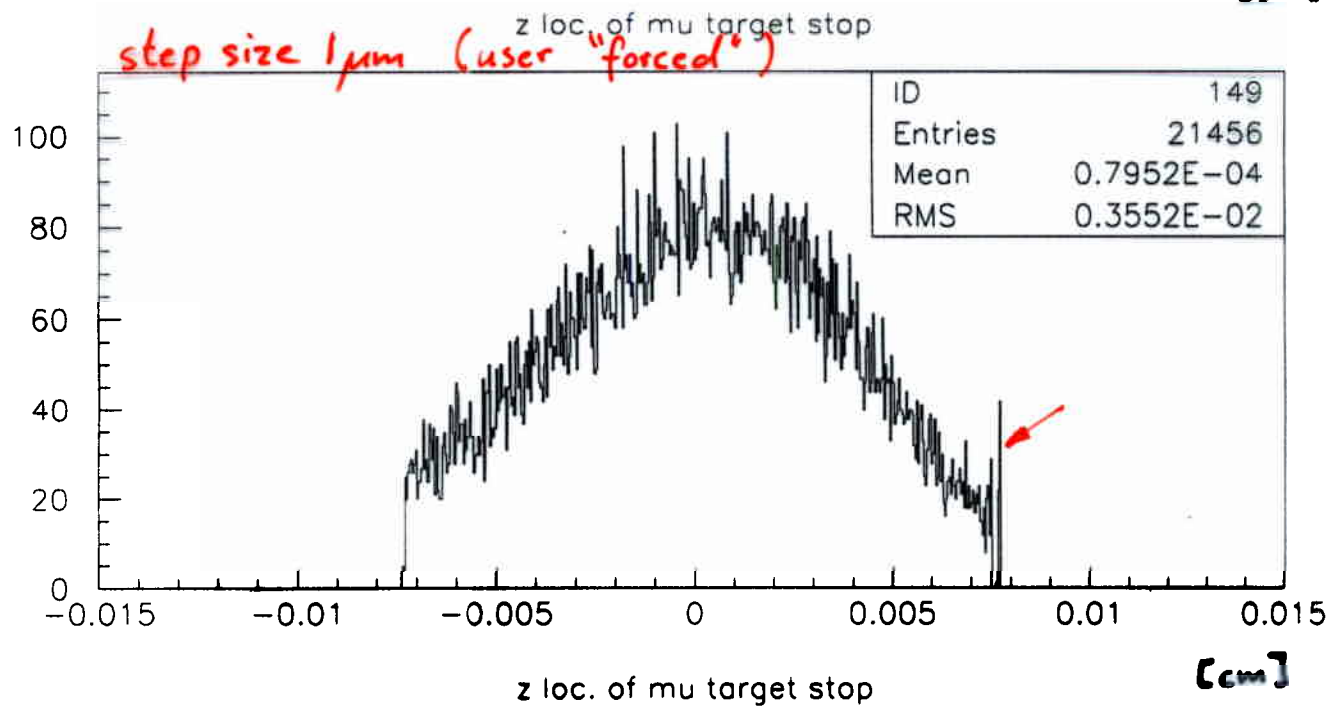
Michel Parameters in Muon Decay

[Yong Liang Zhao, P. Gumplinger, F. Jones]

- **Coop student project [SFU]**
- **Simulation:** complete TWIST detector geometry definition; functionality at the level of E614GEANT (G3) except for hit collection and digitization.
- **Goal:** range out 29.6MeV/c surface muons after many thin mylar layers in a thin ($\sim 150\mu\text{m}$) Al stopping target by way of extra plastic and He/CO₂ gas degrader.
- **Result:** Small steps required in G3 (user optimization) to avoid unphysical results due to tracking cut in energy, while in G4 only one step is taken in the stopping volume due to superior tracking cut on the particle's range.

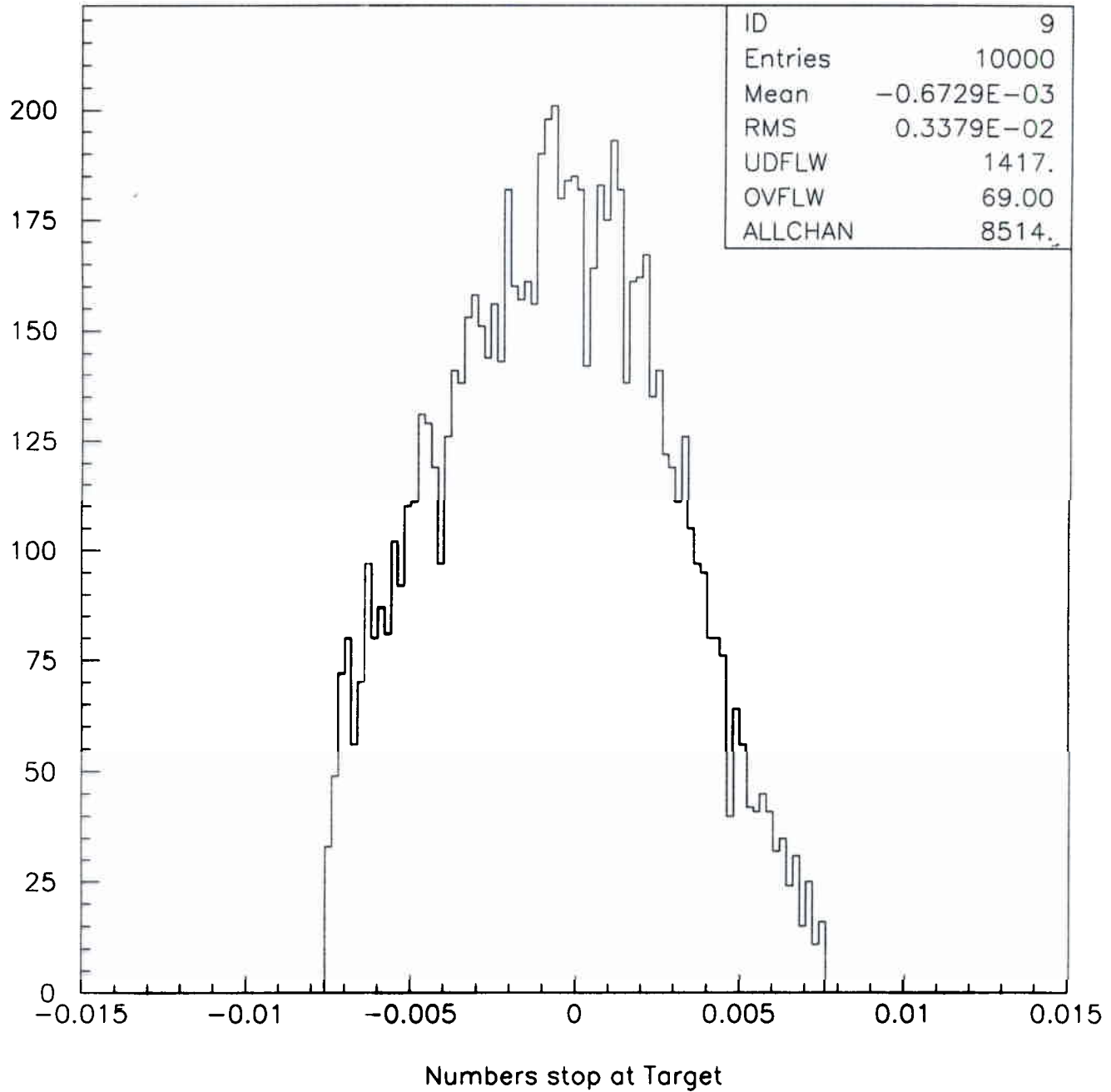




step size $70\mu\text{m}$ (G3 'AUTO'-flag)step size $1\mu\text{m}$ (user "forced")

plastic thickness 0.014 cm

CO₂ Content 70%



Unit = cm

TRIUMF E875

Muon Scattering in Low Z Materials

[R. Edgecock, P. Gumplinger, G. Marshall, B. Murray]

- **Motivation:** Existing data suggests discrepancy with Moliere Theory at large scattering angle; gets worse for low Z elements (problematic in case of hydrogen - muon ionization cooling factor may not be achieved).
- **Experiment:** measure muon multiple scattering and energy loss correlation for: liq. Hydrogen, LiH, lithium, beryllium, aluminum, stainless steel.
- **Goal:** (1) Compare results with basic mult. scattering models (based on Moliere Th.) as implemented in G4.
(2) Distinguish between subtle variations (i.e. using hydrogen wave functions vs. Thomas-Fermi model).
- **Result:** directly feed back to the G4 collaboration