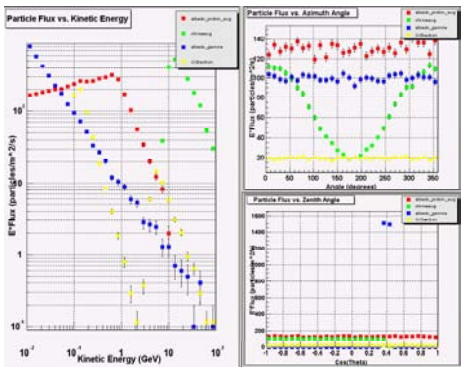
SAS Software:

Sources
Detector geometry model
Simulation
Event and Detector display
Intro to Reconstruction

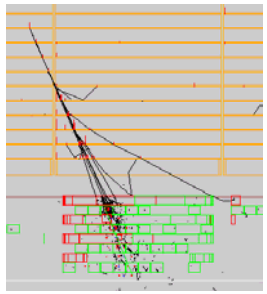
T. Burnett

The Processing chain

Source Fluxes

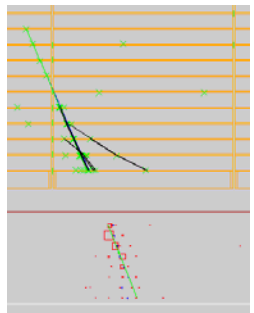


Particle Transport



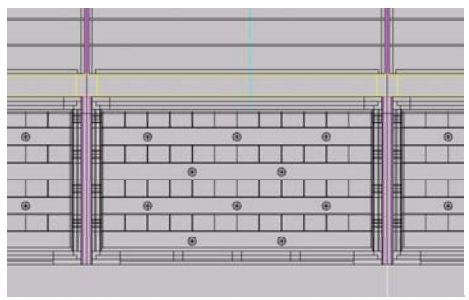
"Raw" Data

Real Data



Recon

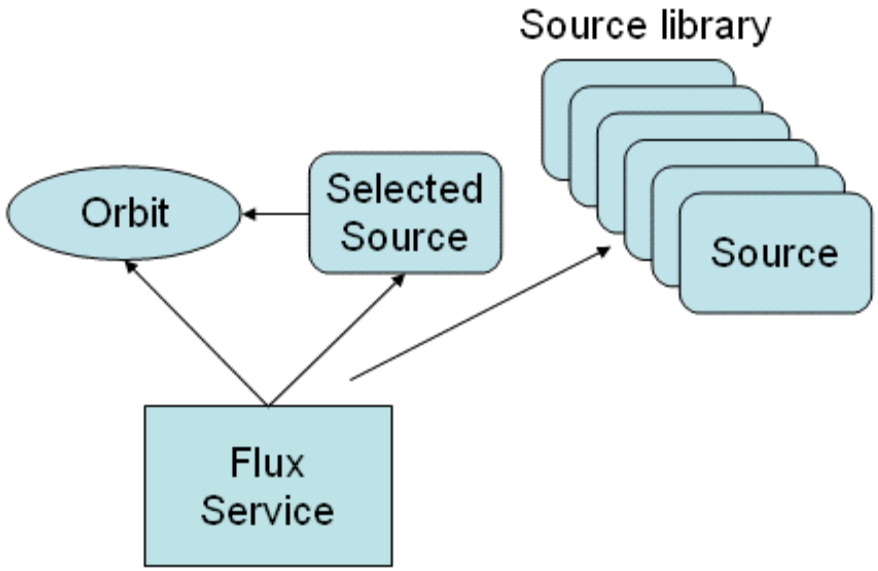
Geometry



Background Rejection - Particle ID

Sources: Incident Flux

- Provides incoming particles for simulation
- Types that must be available:
  - Primary and secondary Galactic Cosmic Rays: protons and electrons
  - Albedo gammas
  - gammas for testing resolution
  - Galactic gamma point sources
  - Galactic diffuse sources
  - Transient sources
- distributions of energy spectra
- angles with respect to:
  - local zenith
  - spacecraft
  - galactic or celestial coords
- Keep track of time
  - for measurement of rates
  - pile-up or deadtime correction
  - for turn-on of transients



Flux Service:
- Selects from library (XML spec)
- Manages orbital parameters
- Returns particles generated by selected source

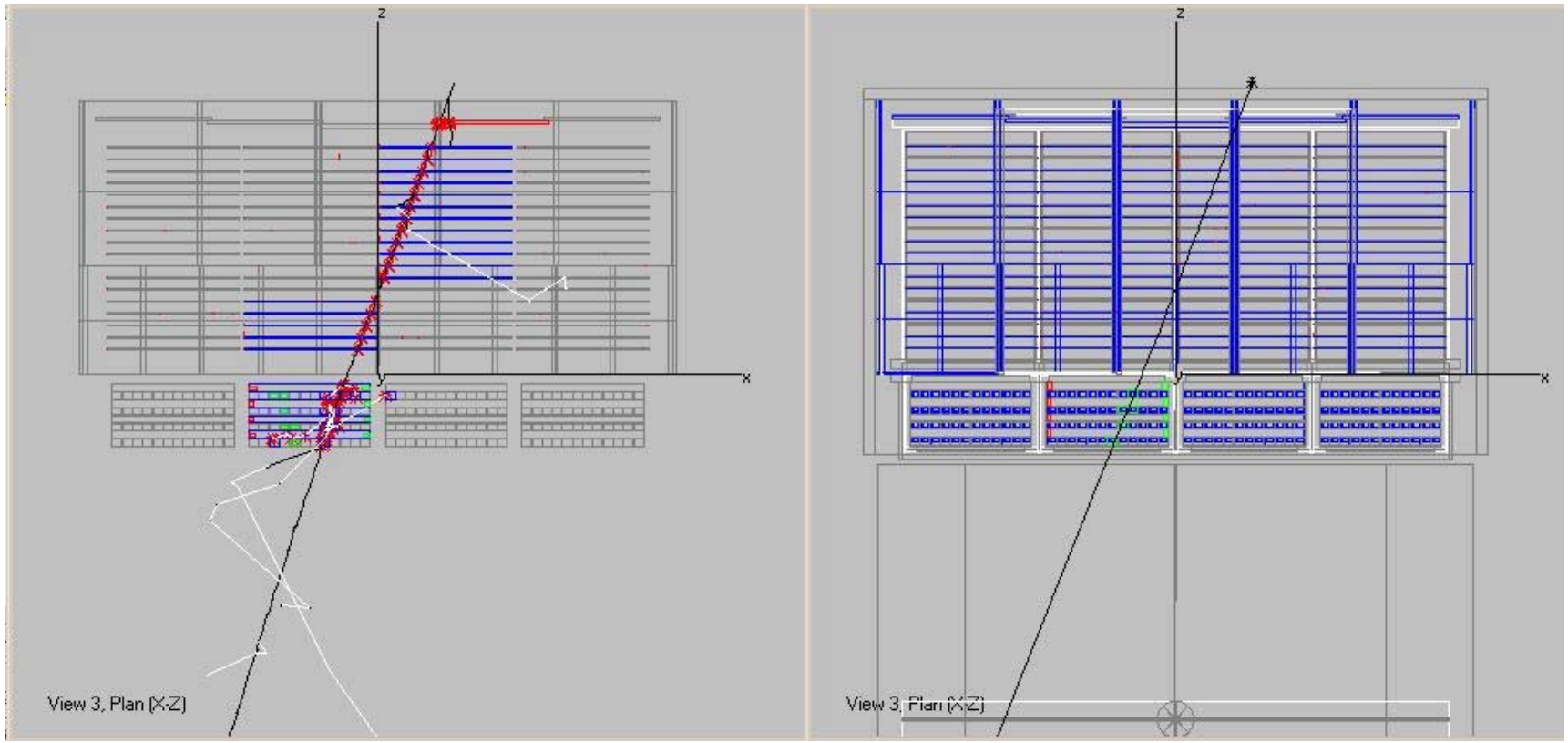
Selected Source: return particles depending on orbit

Simulation: we're in transition

- The simulation results that Steve Ritz presented yesterday were based on three elements that we are replacing.

	Now: Gismo	Future: detModel+Geant4	Benefits
Geometry Description	21 classes, 4380 loc one xml file, 250 lines	data: 6830 lines in 30 xml files code: 8200 loc	•Clean separation between data and code •Easy for different clients to have unique views
Simulation	Physics based on EGS4+Gheisha Supported by 1 person All physics, particle property code in 1 MB of code.	New physics code Supported by 100's Physics and particle properties: 75 MB.	•Better support, documentation. •Becoming standard: many more users to validate physics.
Digitization	Hits turned immediately into digis during simulation	Hits in sensitive detectors, and perhaps all vols, accumulated for later processing	•Energy accounting •Tune digitization independently of simulation

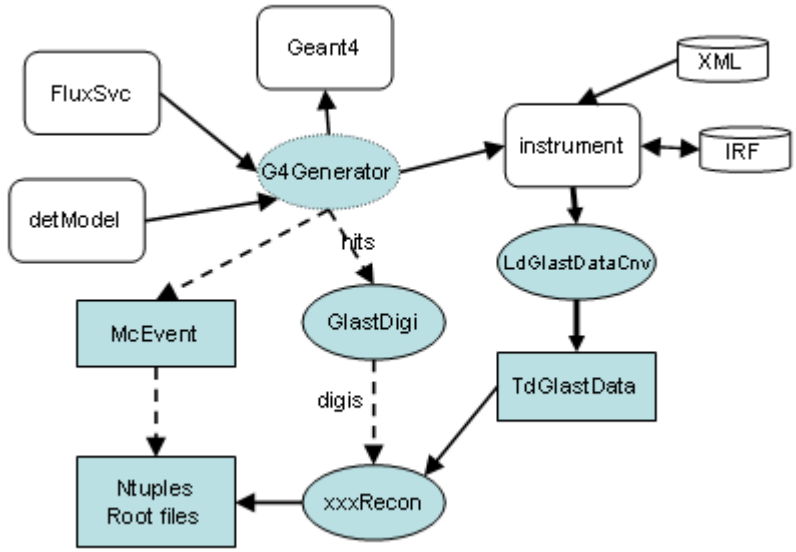
Geant4 vs. gismo



- Incident 2 GeV mu+: Gismo does not support knockons!

Geant4 status: April milestone!

- Done:
  - CMT Interface package
  - Create particles from FluxSvc
  - Control G4 event loop
  - Create G4 Logical, Physical vols from detModel
  - Display hits, tracks
  - Create and send hits to detector objects ("instrument" package)
- Not done
  - Validation of new geometry, physics
  - Fill hit structures
  - Fill Monte Carlo truth
  - Create digis (but TKR close)
  - Detailed comparison with Gismo



Event and Detector display

Interactive 3-D display is vital for debugging

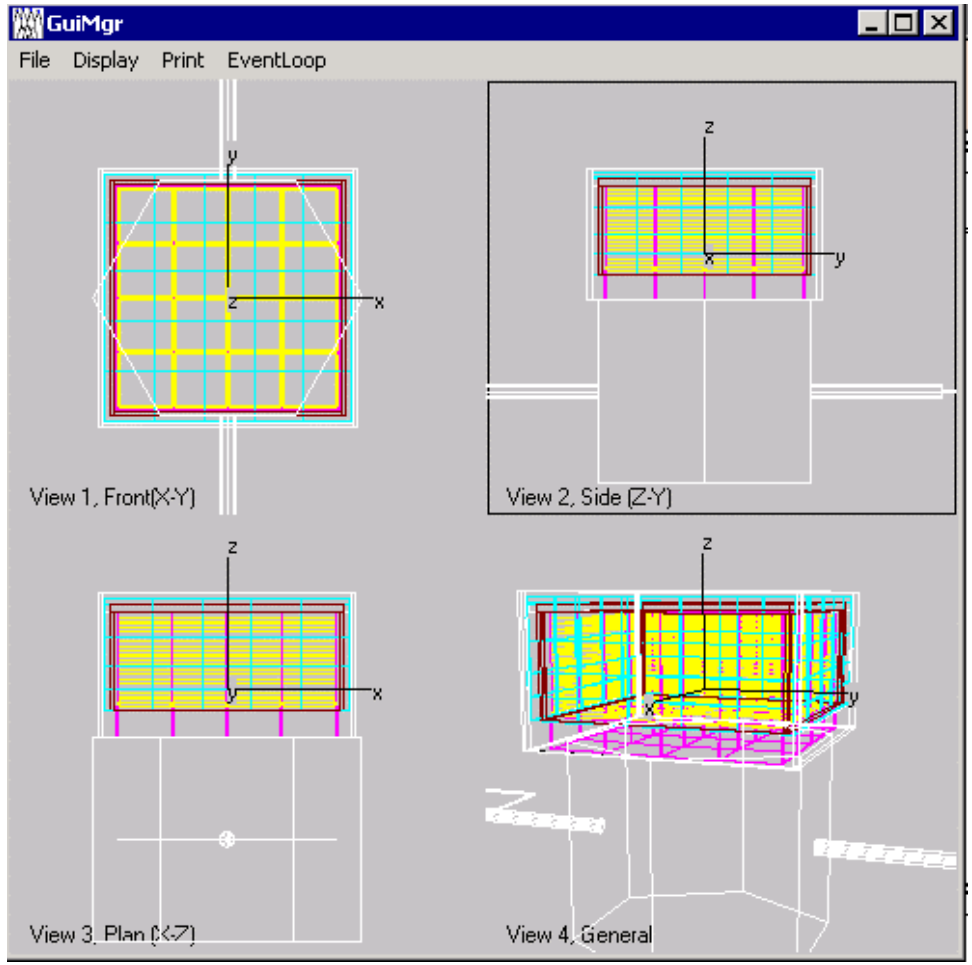
GUI also can control processing

Simultaneous display of

- detector
- hits
- tracks
- reconstruction

We plan to implement HepRep/WIRED as well

Italian responsibilty



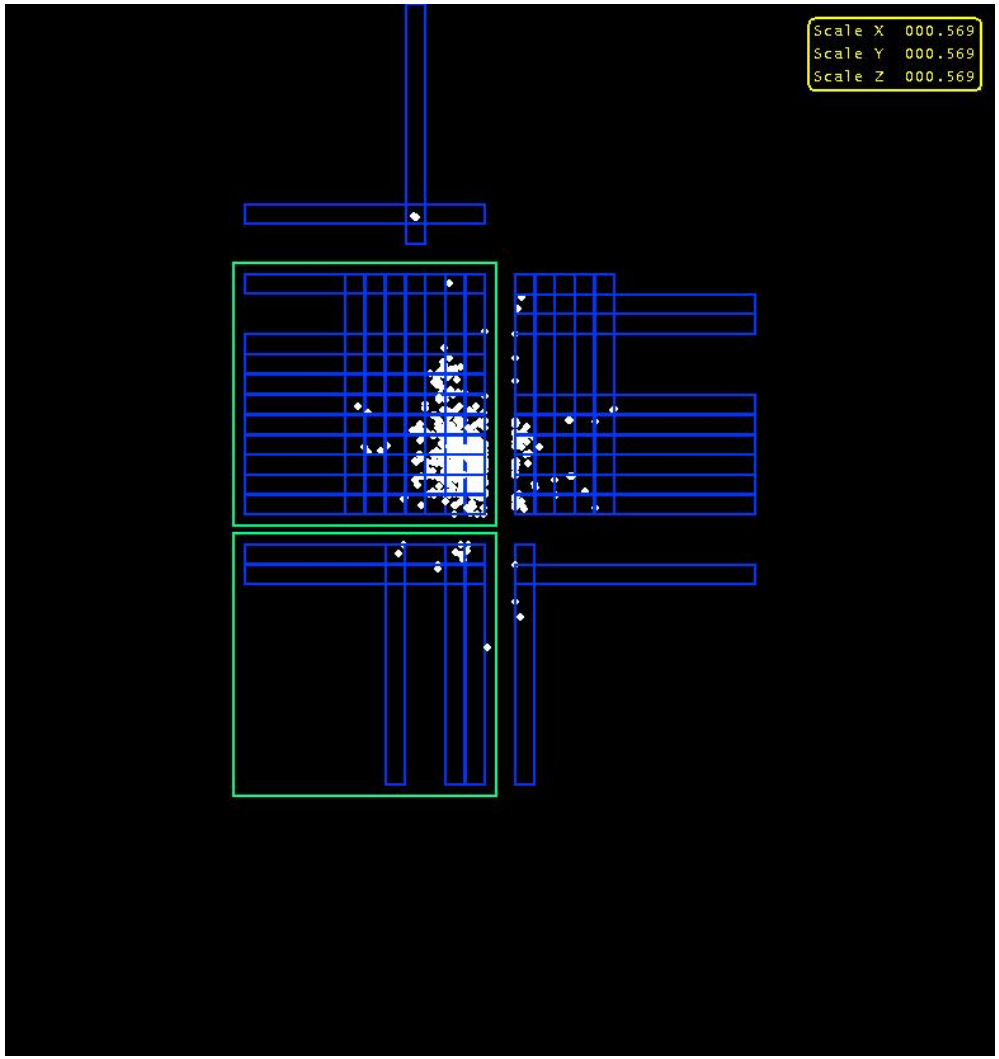
Event Reconstruction in a Nutshell

- Sequence of operations, each implemented by one or more **Algorithms**, using TDS for communication
  - Trigger analysis: is there a valid trigger?
  - Preliminary CAL to find seed for tracker
  - Tracker recon: pattern recognition and fitting to find tracks and then photons in the tracker (uses Kalman filter)
  - Full CAL recon: finds clusters to estimate energies and directions
    - Must deal with significant energy leakage since only 8.5 X_0 thick
  - ACD recon: associate tracks with hit tiles to allow rejection of events in which a tile fired in the vicinity of a track extrapolation
  - Background rejection: consistency of patterns:
    - Hits in tracker
    - Shower in CAL: alignment with track, consistency with EM shower

An easy rejection

Backup slides follow

Example of Wired event display

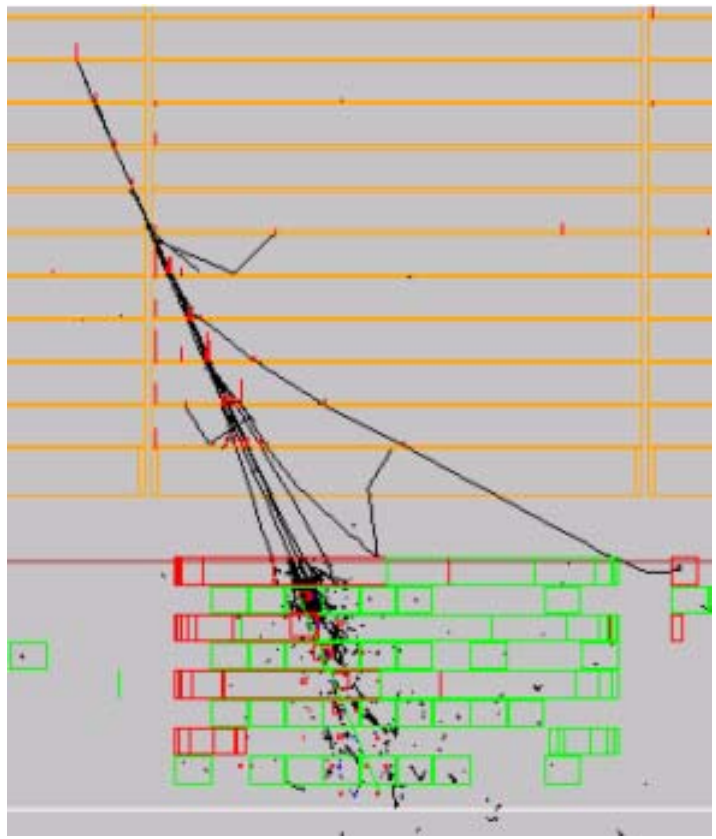


Depositing energy: bookkeeping design

- Particles transported by the simulation deposit energy in matter by ionization loss, in many small steps
- Each loss is associated with the given volume, two strategies
  - Single-step: every step saved
  - Volume integrating: only keep total, perhaps in subdivisions
- Primary objective: create realistic detector response
- Secondary objective: preserve enough information about the underlying event to guide design and evaluation of reconstruction strategies
  - Parent particle: incoming or e+/e- from pair conversion

3 GeV photon interaction (charged particles shown only)

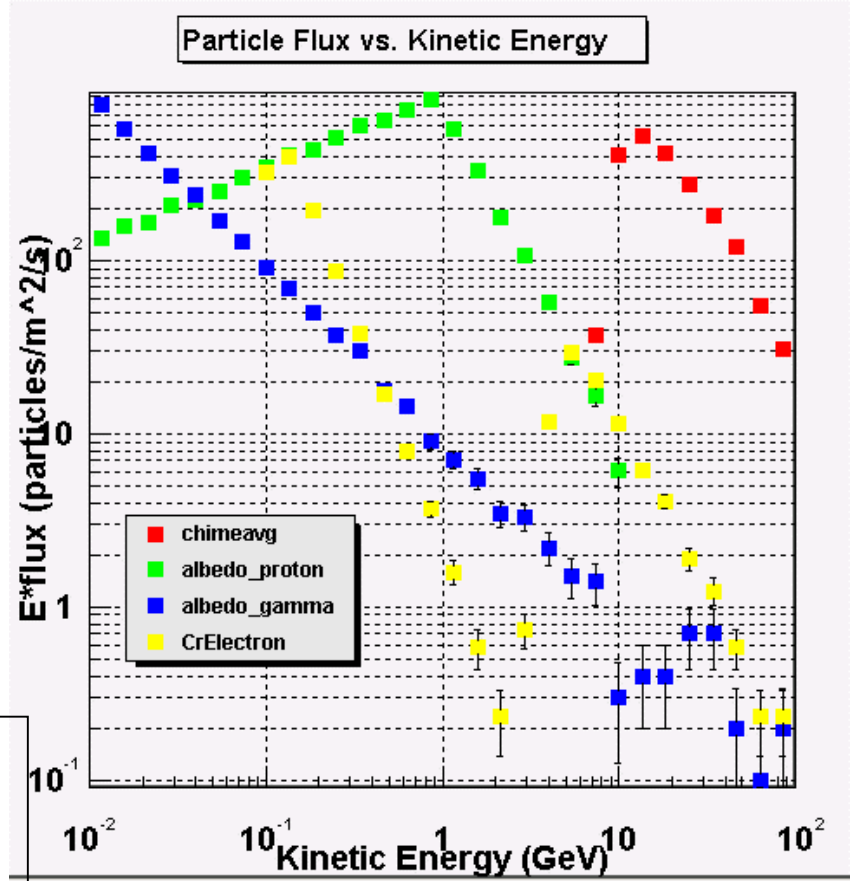
Detector responses shown



Rootplot: A useful utility to study sources

Plot at right generated by a utilty program in the flux package.

Can choose any combination of sources described in the XML file, and generate distributions of energies and angles that would be provided to the service.



Plot of the energy spectra for various components of a proposed background mixture,

including: :

•chimeavg, representing a average rate for the CHIME model of primary proton cosmic rays;

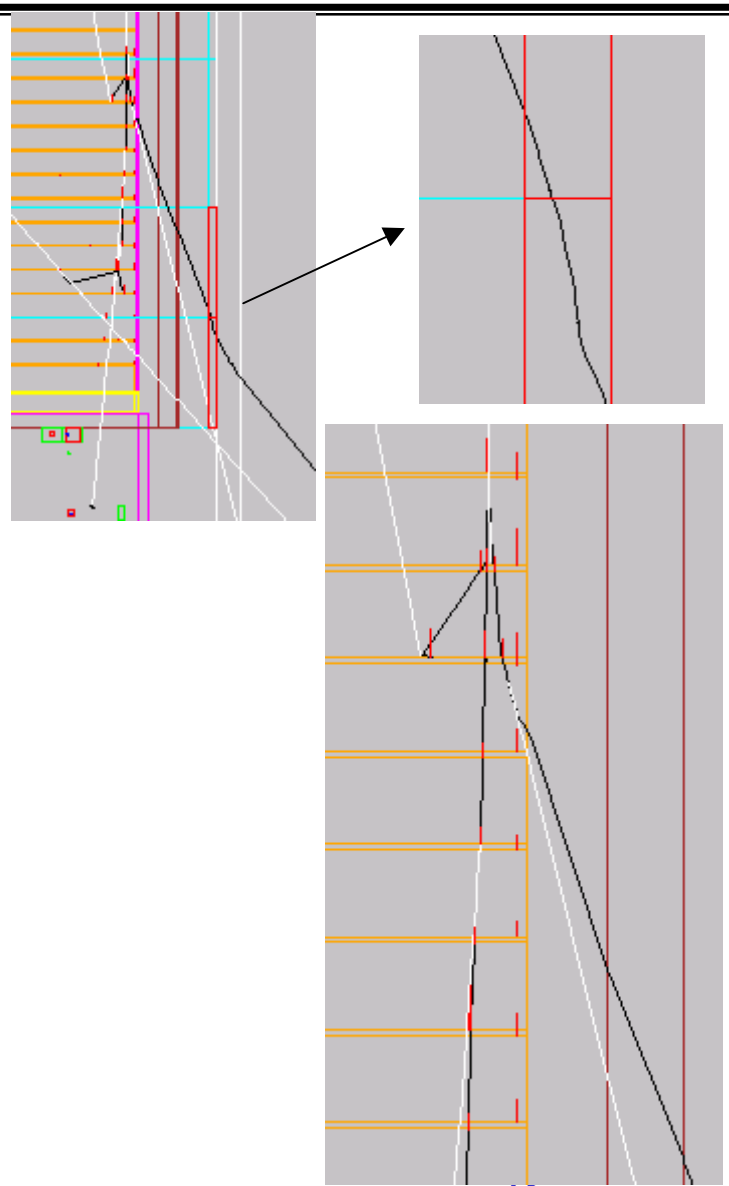
• albedo_proton, the spectrum of albedo and reentrant protons corresponding to recent measurements;

• albedo_gamma, secondary gammas from the horizon, and

• CrElectron, a mixture of primary and secondary electrons and positrons. The abscissa is the kinetic energy of the particles (gamma, proton, or electron) in GeV, and the ordinate the flux times energy integrated over angles, in particles/(m2 s).

Digitization Requirements

- ACD
  - total energy deposited
  - position of all steps and associated MC parent particle
- TKR
  - the dead material energy loss must be segmented at least by plane
  - Silicon treated as one volume, but complete detail of each step in the silicon.



Digitization Requirements

- CAL
  - Each crystal treated as single volume
  - Impractical to save every step in a big shower
  - Accumulate energy sums in slices.
  - Also register energy sum and energy-weighted longitudinal position moments.
  - Turn the resulting info into the four PIN diode readouts