Comparisons of FCal1 Module 0 Testbeam Electron Signals with GEANT3 Simulations

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- Reconstruction of Monte Carlo data
- Event selections
- Signal linearity and resolution
- Shower shapes
- Resolution optimization

Reconstruction of Monte Carlo Data

- Visible energy in individual electrodes is collected into tiles using the experimental cabling/readout description database;

- Experimental noise from randomly triggered "empty" events is added cell by cell, using the experimental and Monte Carlo electron calibration constants c_{exp} (in GeV/ADC) and c_{MC} (inverse sampling fraction):

  $E_{rec} = c_{MC} E_{vis} + c_{exp} A$ [GeV]

  in any given tile, with A being the noise signal in ADC counts.
  c_{exp} has been calculated from the average 60 GeV electron signal; c_{MC} has been determined correspondingly at the same beam energy.

Event Selection

- High energy beam in H6 was contaminated with pions (120 and 200 GeV)

- Beam envelope criteria is used to separate electrons and pions at 200 GeV

- Energy sharing between the FCal modules, as measured by

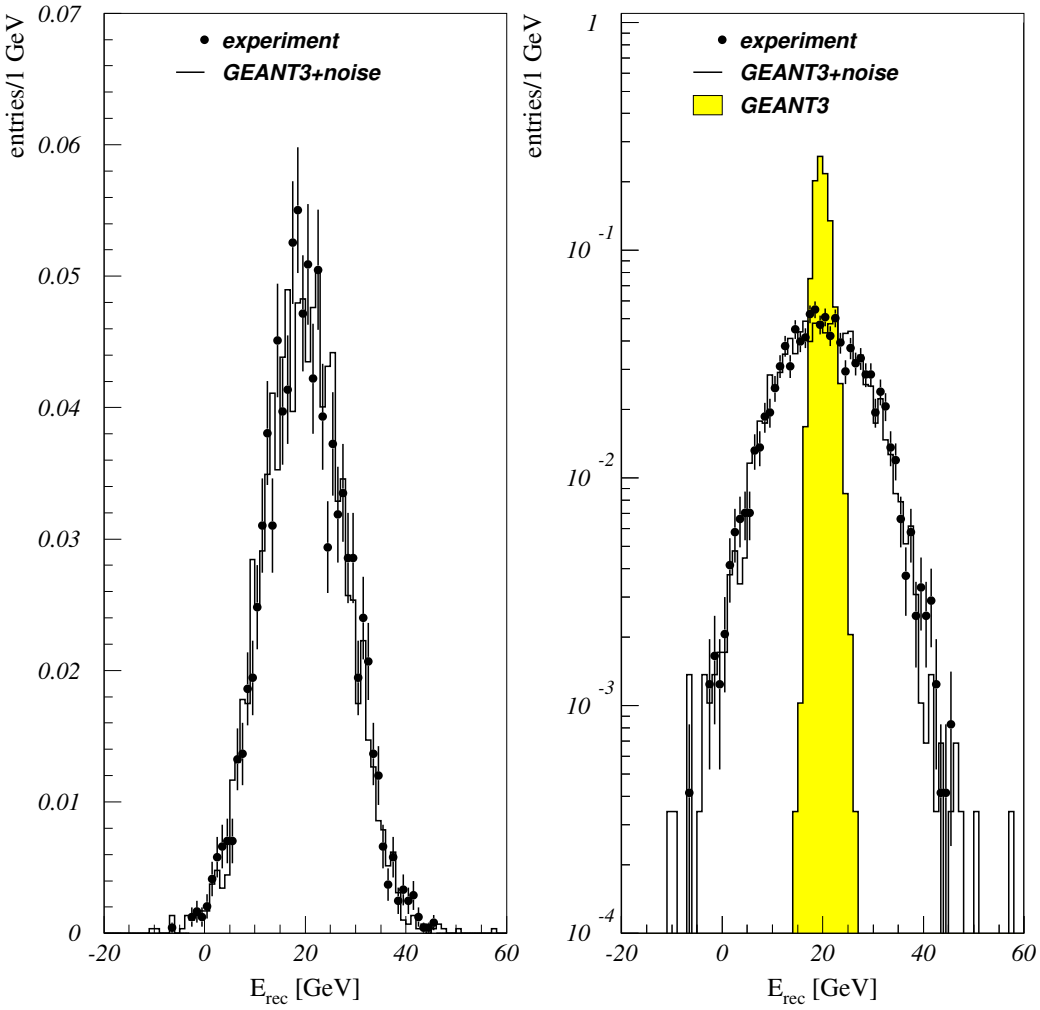
  $E_1 / (E_1 + E_2)$

  and shower compactness measured by

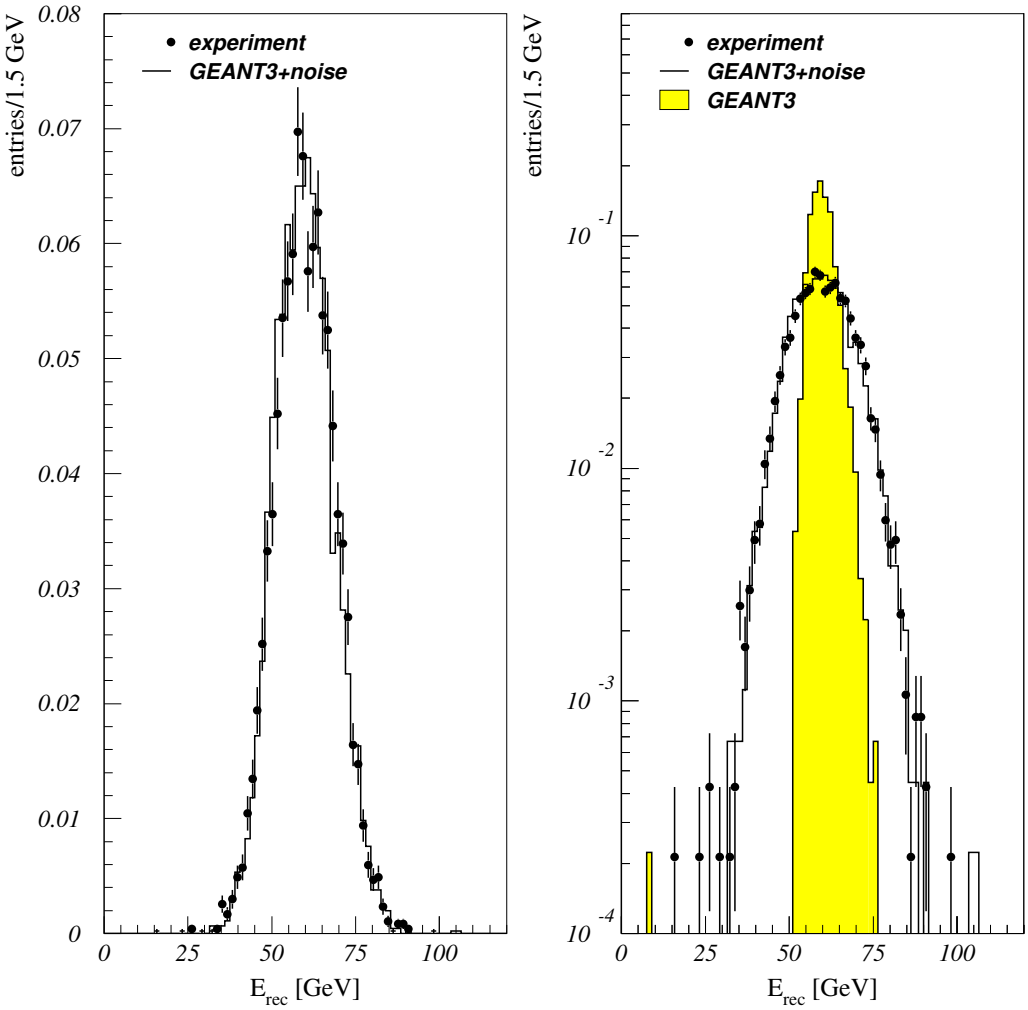
  $E_{1,max} / E_1$

  are used to select electrons at all energies.

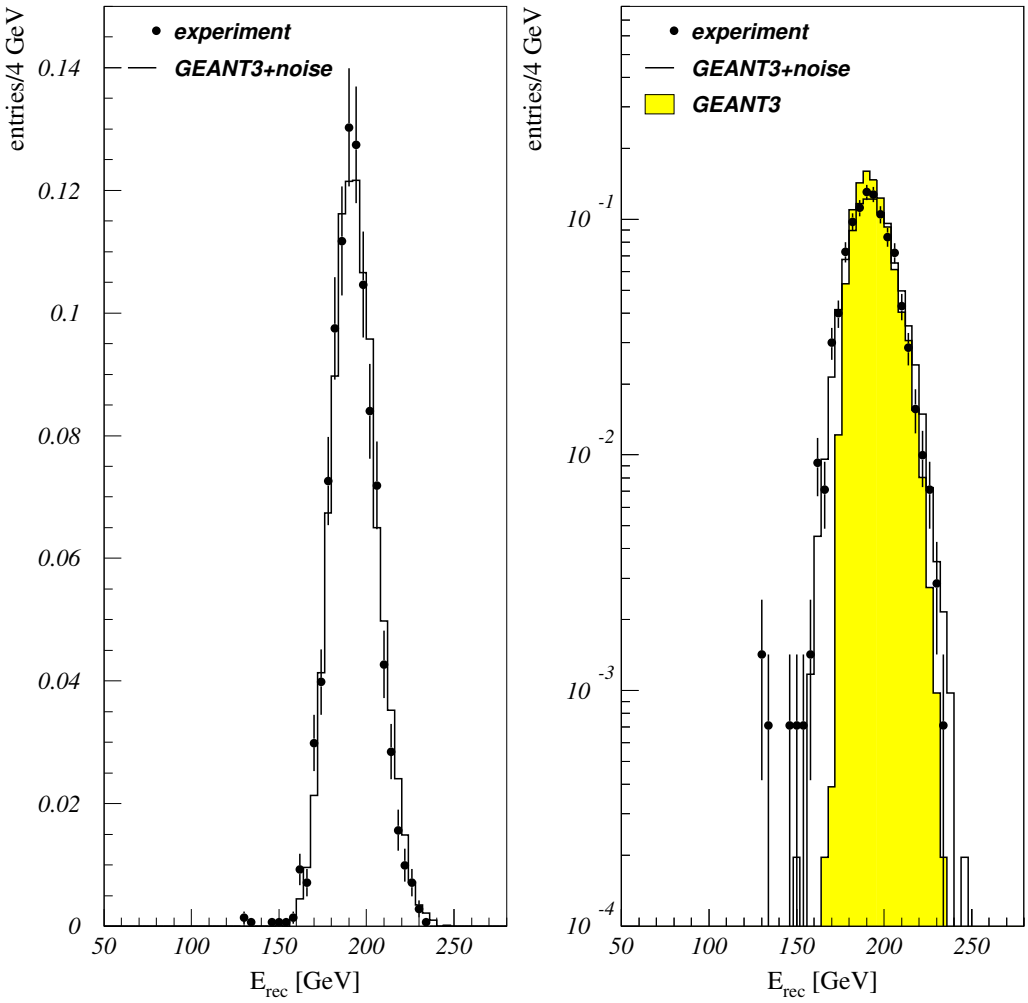
20 GeV Electron Signal Distributions



60 GeV Electron Signal Distributions

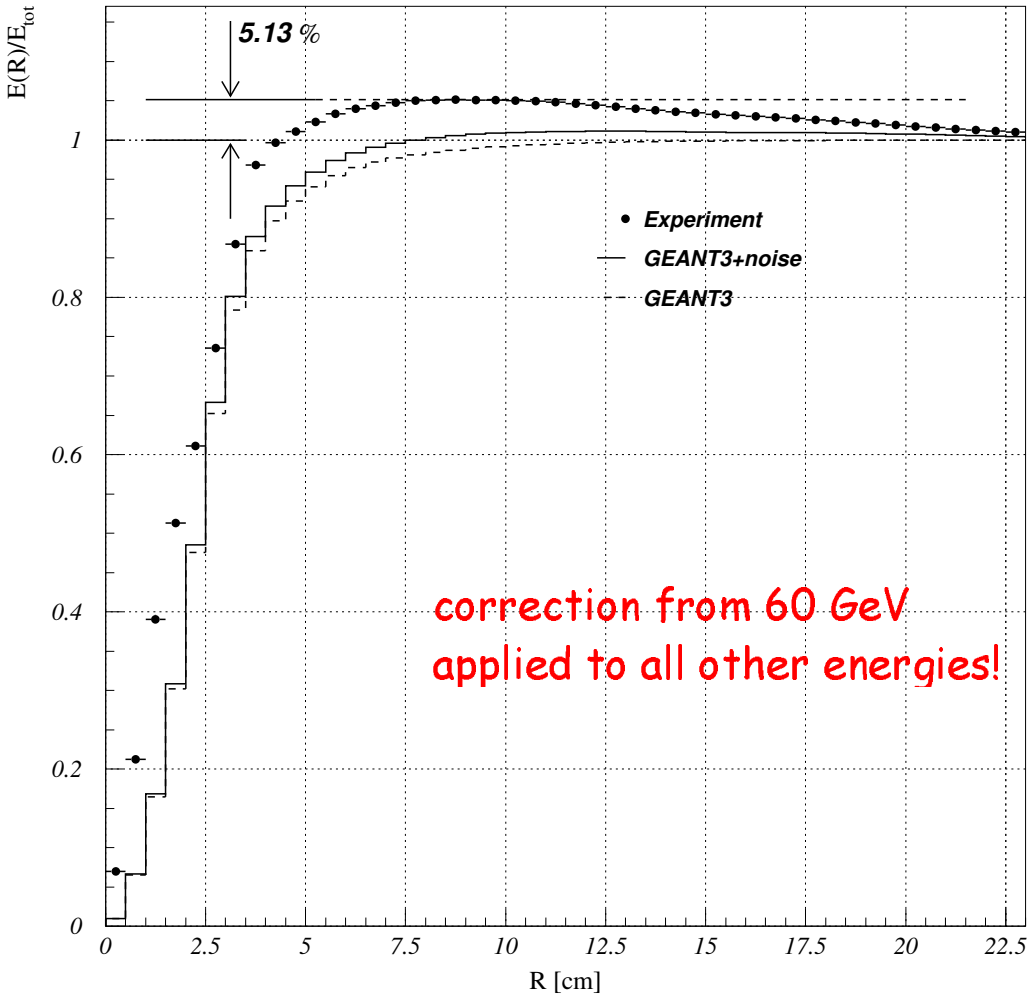


200 GeV Electron Signal Distribution



looks quite good, but ...

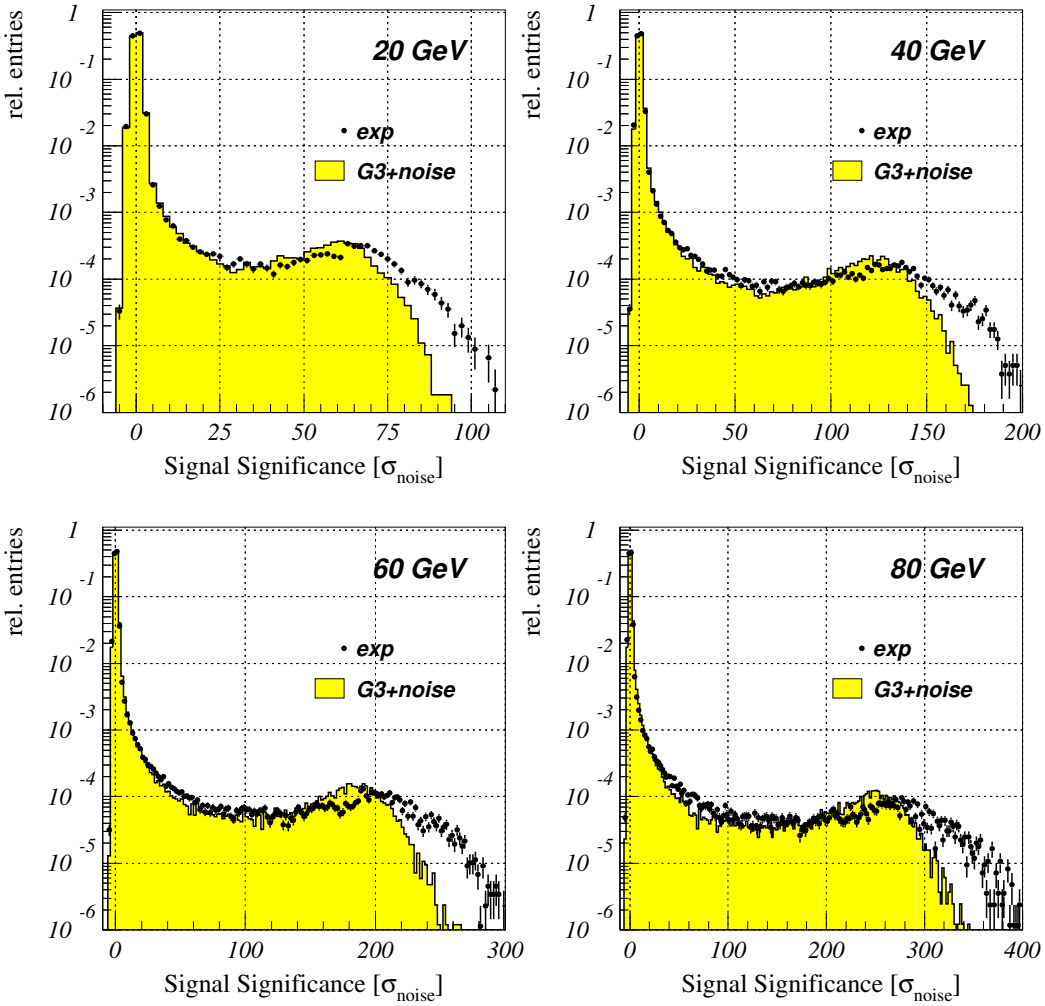
60 GeV Integrated Radial Shower Profile



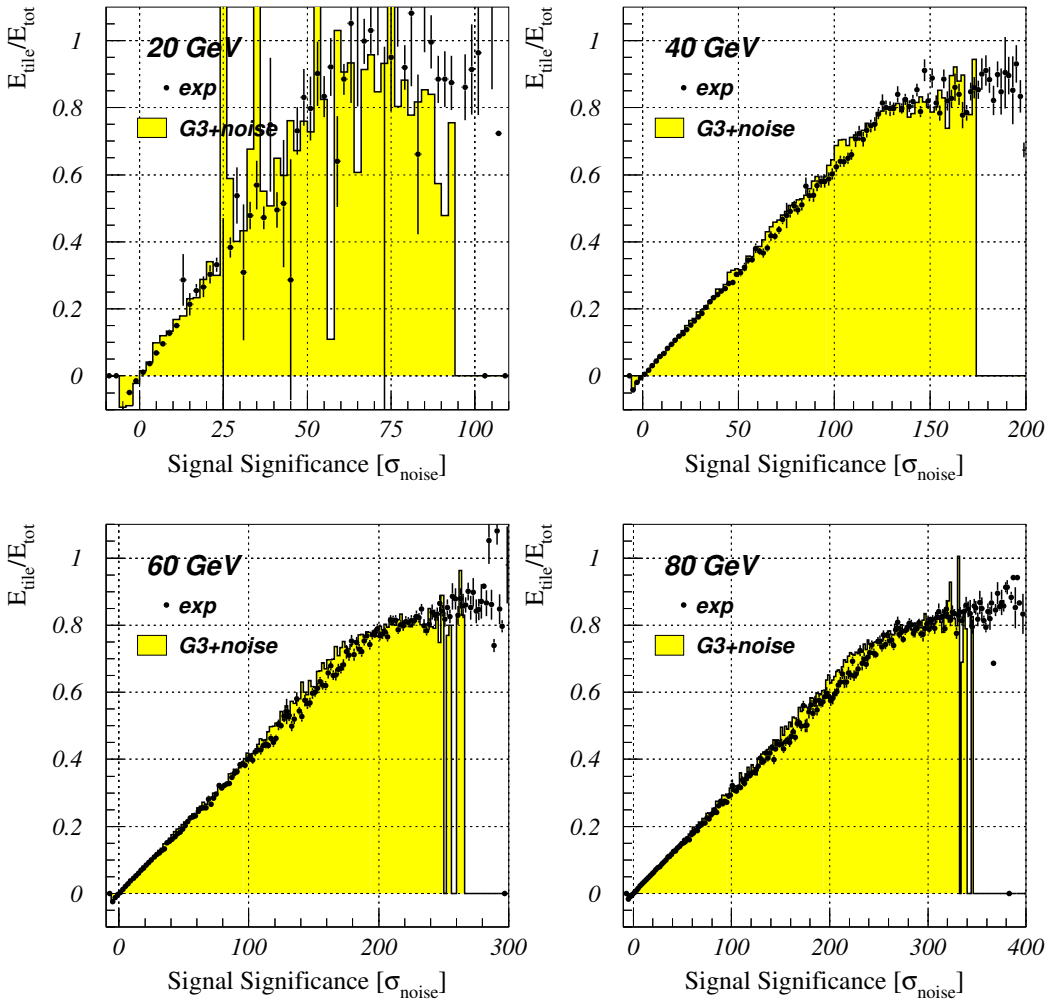
…negative X-talk around shower reduces the total signal in the experiment (not sufficiently reflected in the noise!)

Detailed Look at Signal Composition

more highly significant signals in experiment and …



Detailed Look at Signal Composition



… on average higher contributions from less significant signals to the total signal in GEANT3!

FCal1 Electron Response

- Studied for various analysis cuts:

  1. Sum all tiles in FCal1 for total energy;

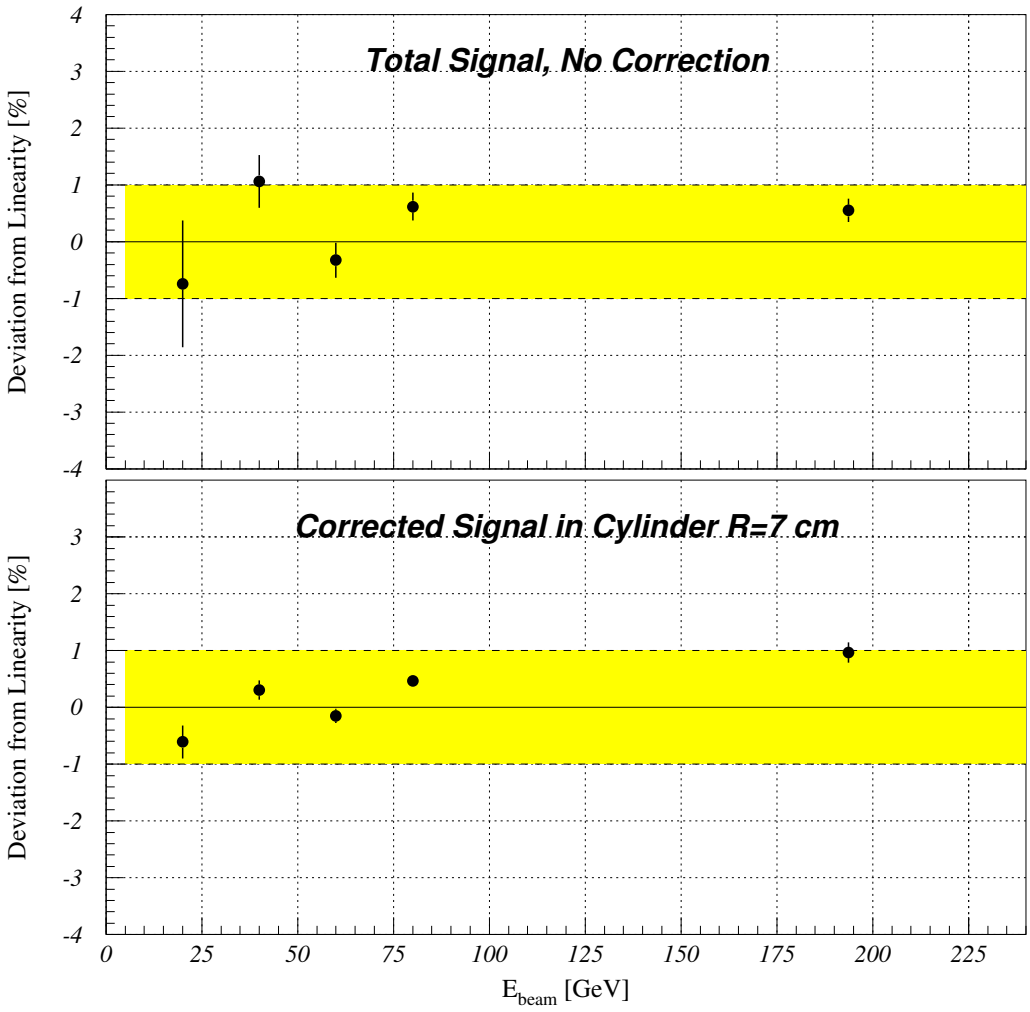
  2. Collect signal in cylinders of various radii;

  3. Apply symmetric noise cut to tile signals and include only signals > n x σ_{noise} and signals < -n x σ_{noise} in total energy sums;

All analysis cuts are applied to data and Monte Carlo in exactly the same way.

FCal1 Electron Signal Linearity

... is defined by the ratio $(E_{sim} - E_{exp}) / E_{exp}$...

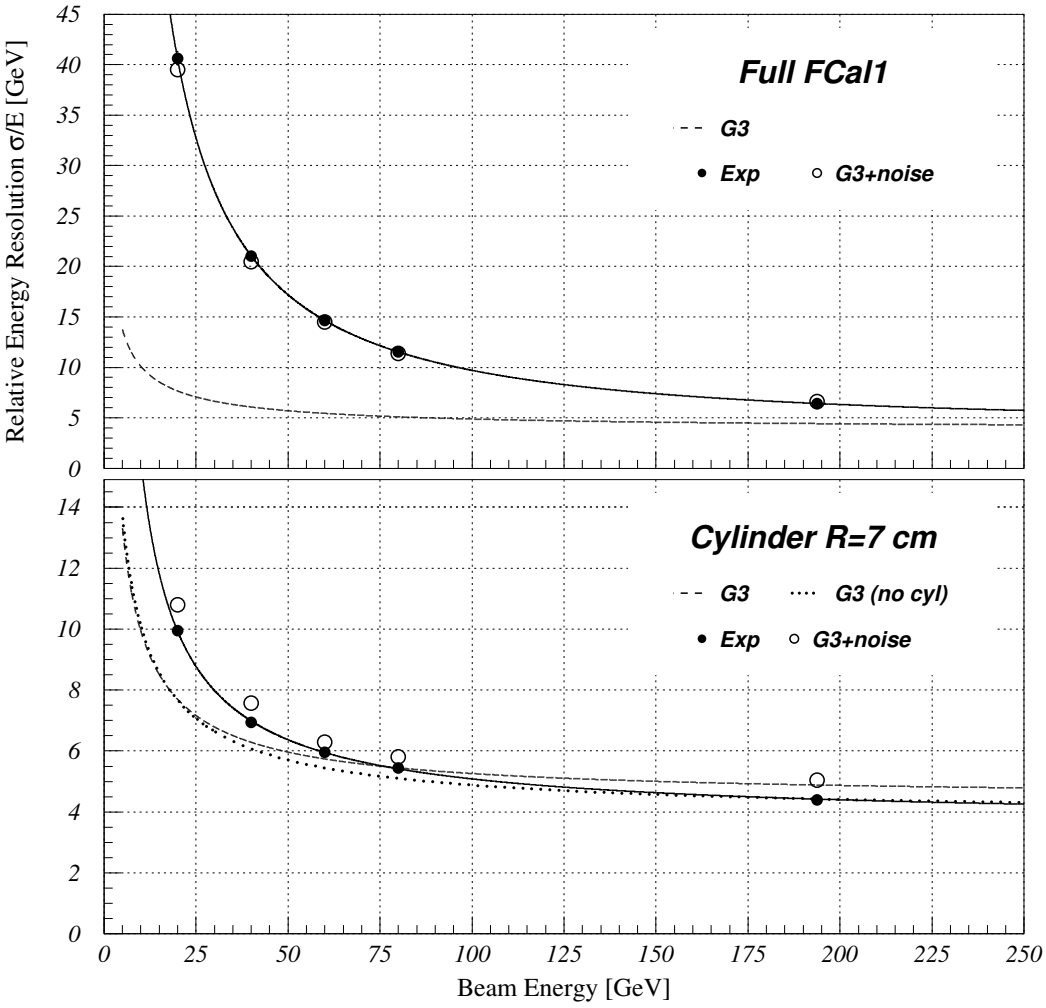


FCal1 Electron Energy Resolution

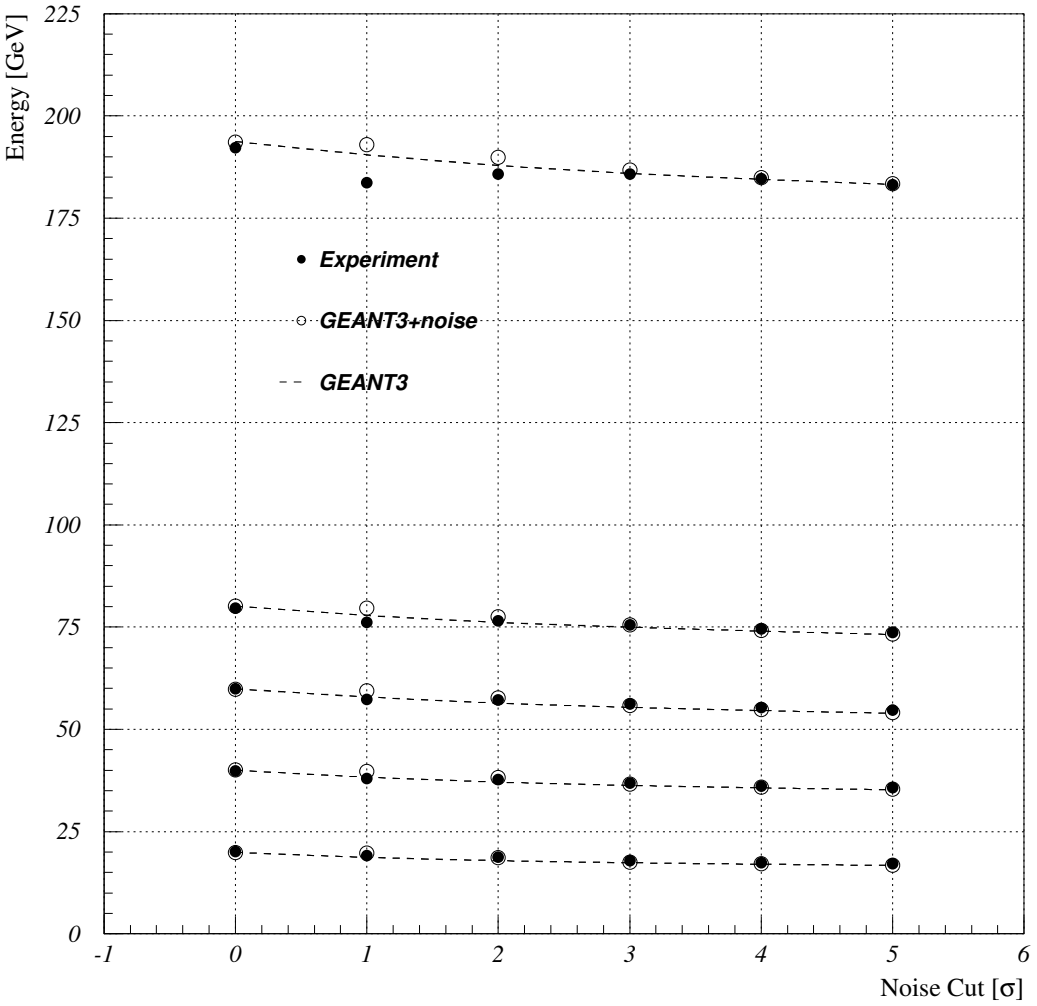
- Effects of radial cuts depend on quality of the impact point determination (from MWPC tracks in the experiment and KINE tracks in the simulation -> may introduce differences in the resolution!

- The weight of the noise signal in the Monte Carlo can be about 5% too high, due to the X-talk effect discussed earlier -> will again effect the resolution!

FCal1 Electron Energy Resolution

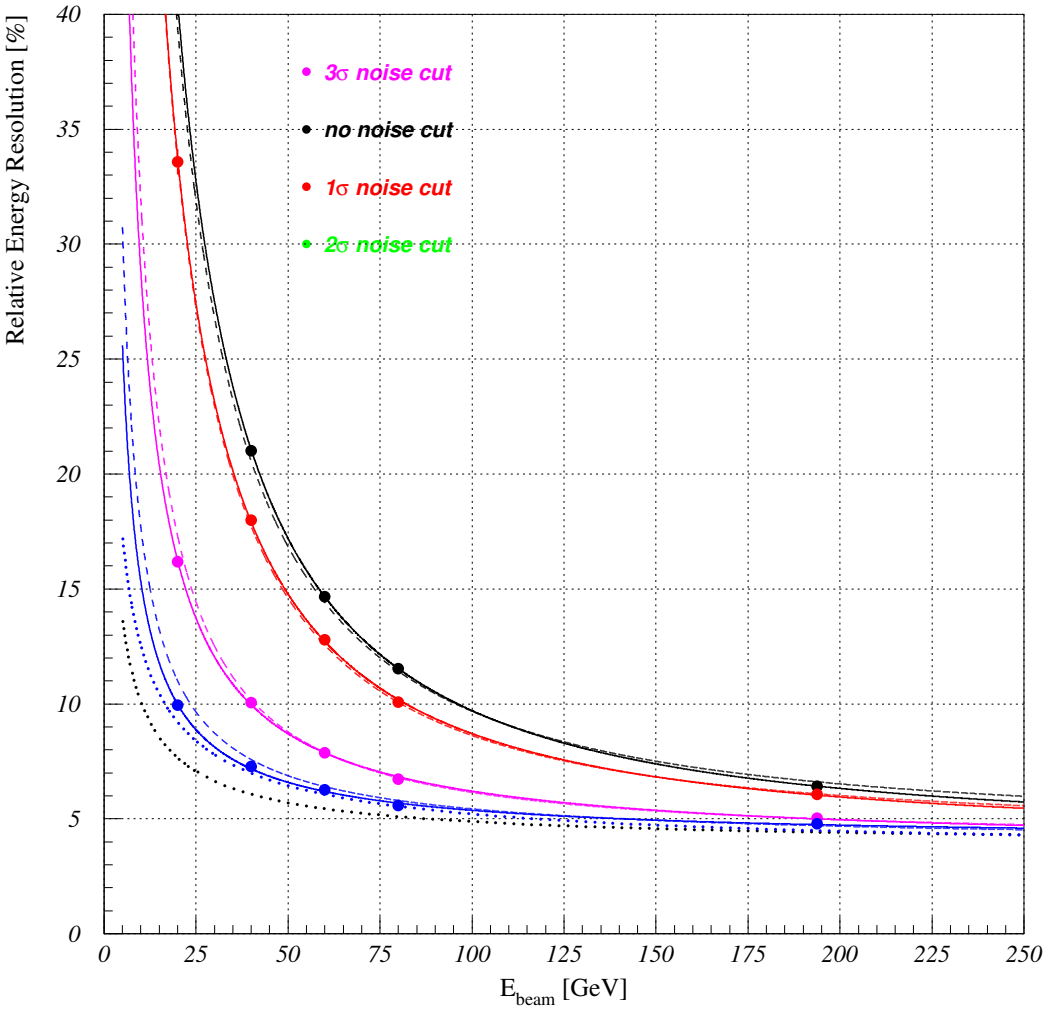


Electron Signal for Various Noise Cuts

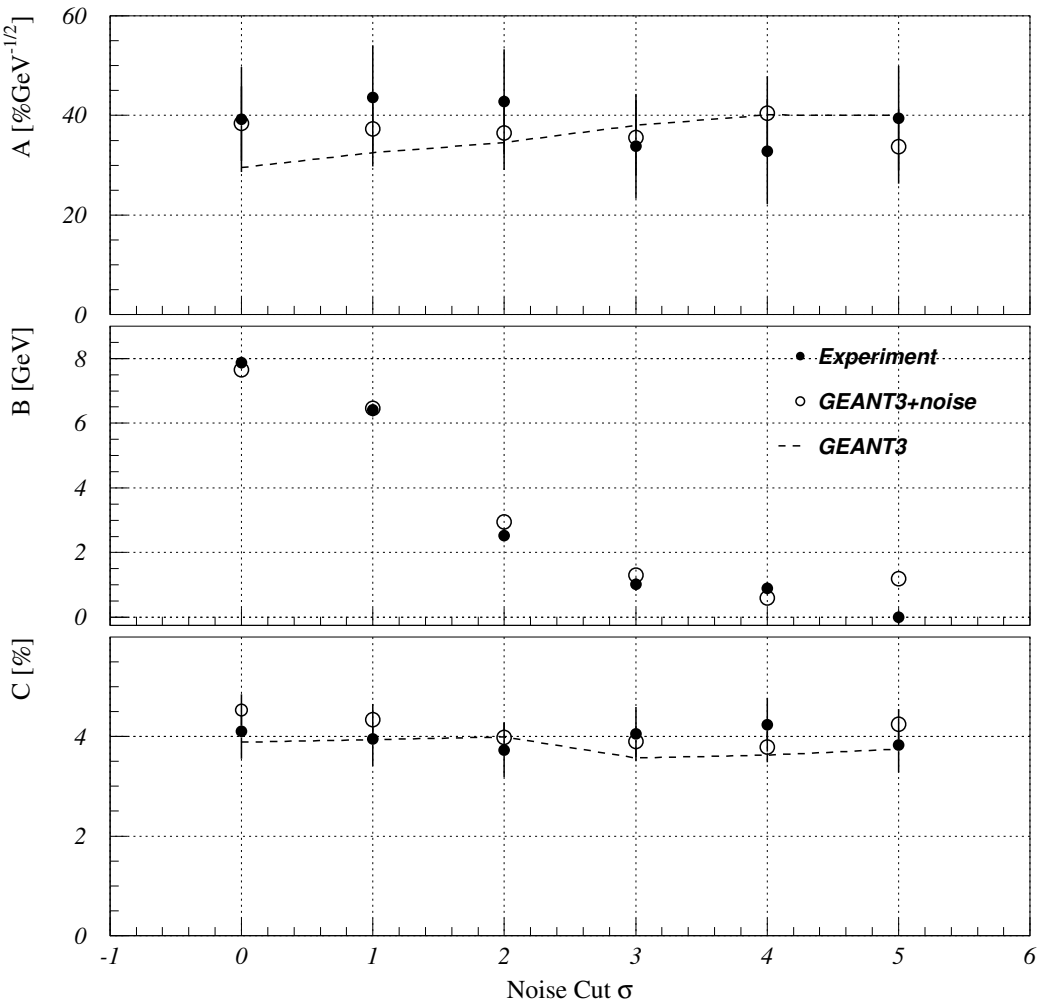


…behavior at lower noise cuts not understood yet!

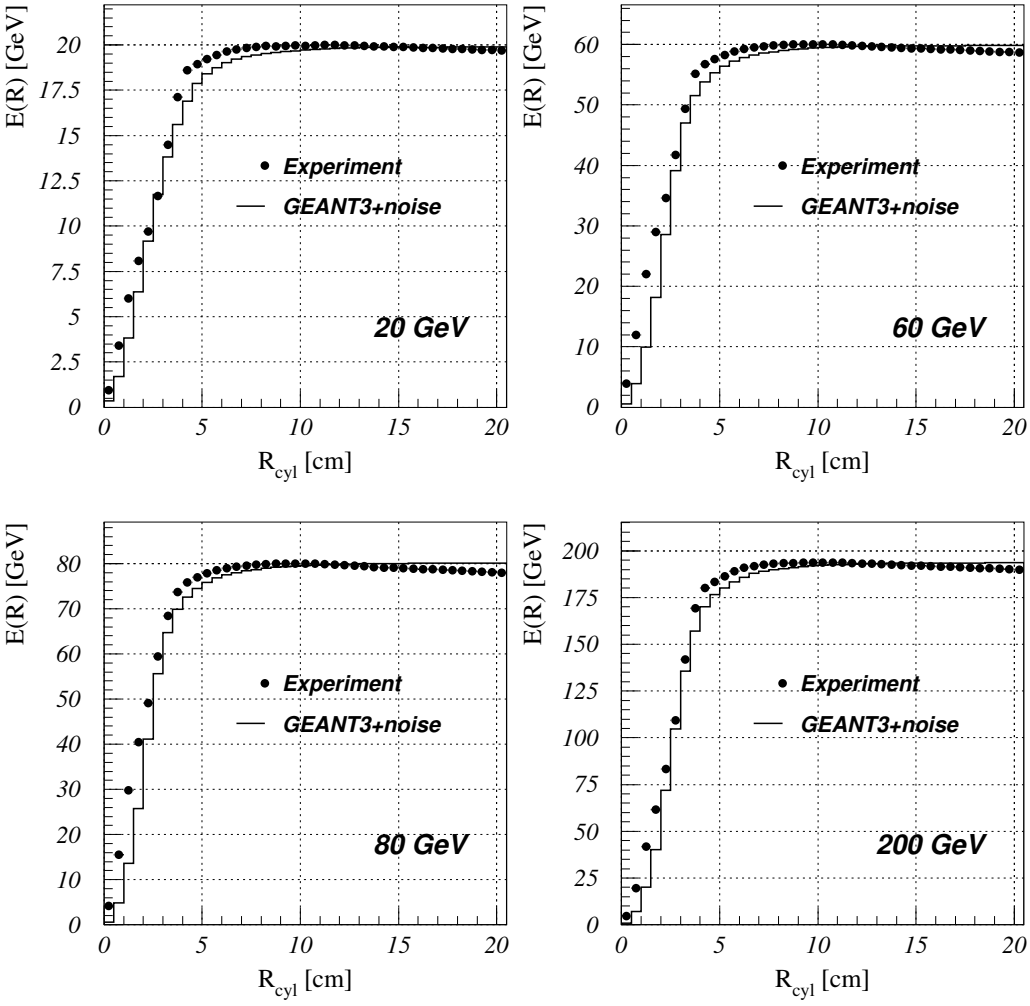
Electron Energy Resolution for Various Noise Cuts



Fitted Resolution Parameters

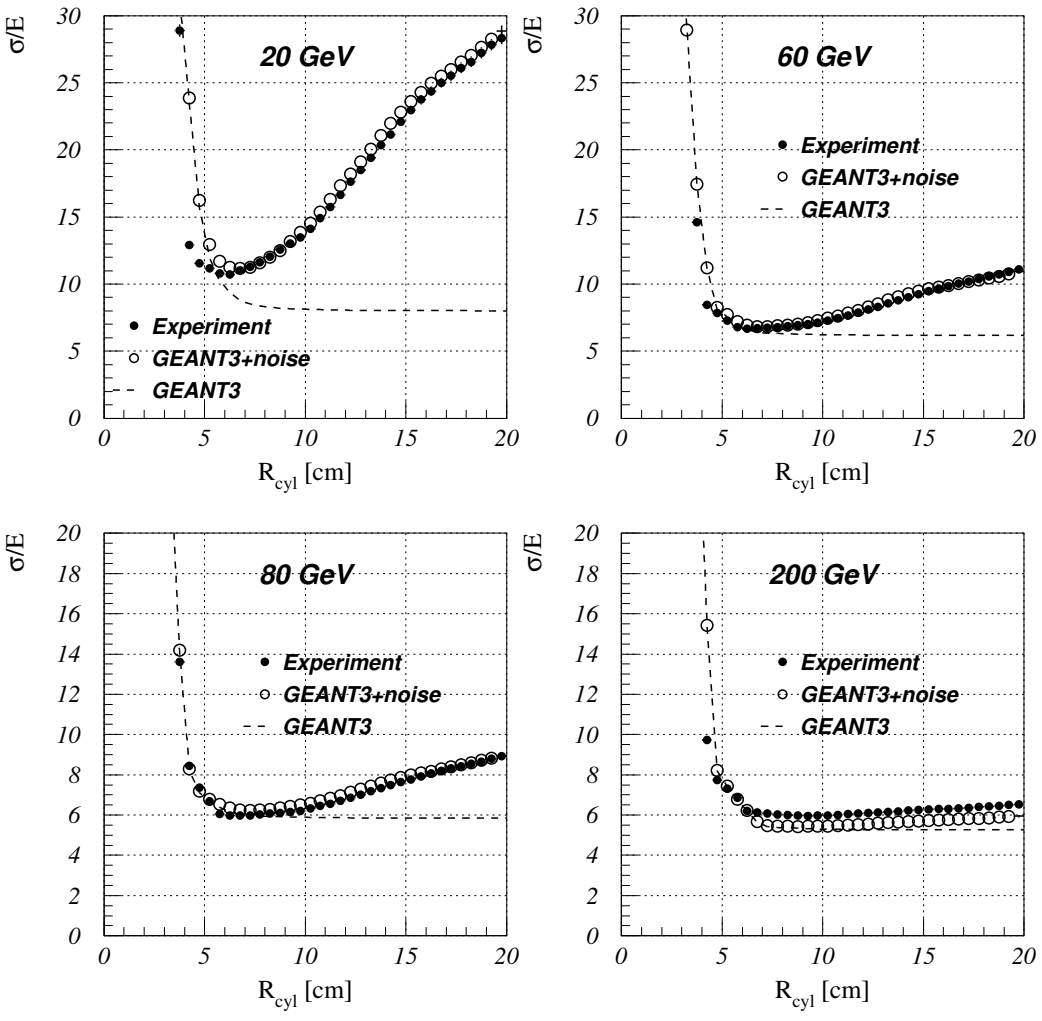


Radial Shower Development



...as suspected earlier, showers are more compact in the experiment (X-talk ?)

Signal Fluctuations in Cylinders



Conclusions and Outlook

- 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;

- more detailed comparisons of shower development (cell signal significance, lateral shower profile) are probably affected by the X-talk in the data -> noise contribution added to Monte Carlo may be too high by order 5%, due to shift in experimental calibration;

- still missing is a comparison to Geant4 (production running now at Montreal and Arizona)...