Electron Signal Studies for the ATLAS Forward Calorimeter

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Outline

- Introduction
  - Shower characteristics for electrons/pions in our Calorimeter
  - Event selection for electrons
- Results
  - Linear response requirement
  - Resolution
- Outlook and Conclusions
It is a primary consideration for a calorimeter that the signal is directly proportional to the energy deposited by the electron (signal linearity).

It is a requirement of physics in ATLAS that deviation from linearity be:

$\pm 1\%$ for Electrons
$\pm 5\%$ for Pions
The error of the energy measurement in a calorimeter is determined by its resolution.

Resolution for each energy is determined from a gaussian fit of the signal spectrum.

Gaussian fits were restricted to reduce pion background at 120 and 200 GeV.
Electron Resolution (2)

The usual model to describe the energy dependence of the resolution is: \( \sigma/E = (a^2/E + b^2/E^2 + c^2)^{1/2} \)

- **Sampling Term**: \( a \) - all effects from the stochastic nature of the signal
- **Noise Term**: \( b \) - all effects on the measurement from the read-out electronics
- **Constant Term**: \( c \) - high energy limit on the resolution introduced by the specific detector design
Improved Signal Definition

- Resolution is dominated by noise contribution, especially at low energy (20 - 60 GeV)
- To reduce noise contribution collect signal in cylinders around particle direction
- Finding the ‘best’ cylinder radius - two factors: Resolution Response
Conclusions

- Deviation from linearity is well within guidelines established for physics in ATLAS, ± 1% for electrons.
- Electron resolution is sufficient with first cuts.
- Collecting signal in cylinders helps reduce the contribution from noise and improve the resolution giving a sampling term around 27% and constant term around 4.4%.