Linearity & ADC resolution in simulation

Carlos MUÑOZ CAMACHO, WANG Pu-Kai

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- **Study the energy resolution by varying:**
  - ADC resolution: 12, 14, 16 bits
  - non-linearity in electronics

- **Standalone simulation:** epic_brycecanyon.xml (latest geometry)

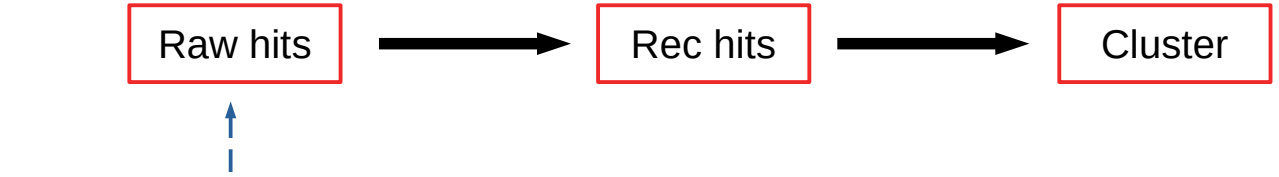
- **Single particle gun:**
  - particle: γ
  - Energy: 1, 2, 5, 10, 15, 20 GeV (10k events for each bin)
  - uniformly distributed, **η** from -1.87 to -3.14 (NEEMC acceptance: -1.79 to -3.55)

ADC resolution

- **Dynamic range is 20GeV:**
  - 12 bits → 4.9 MeV / bit
  - 14 bits → 1.2 MeV / bit (default in EICrecon)
  - 16 bits → 0.3 MeV / bit

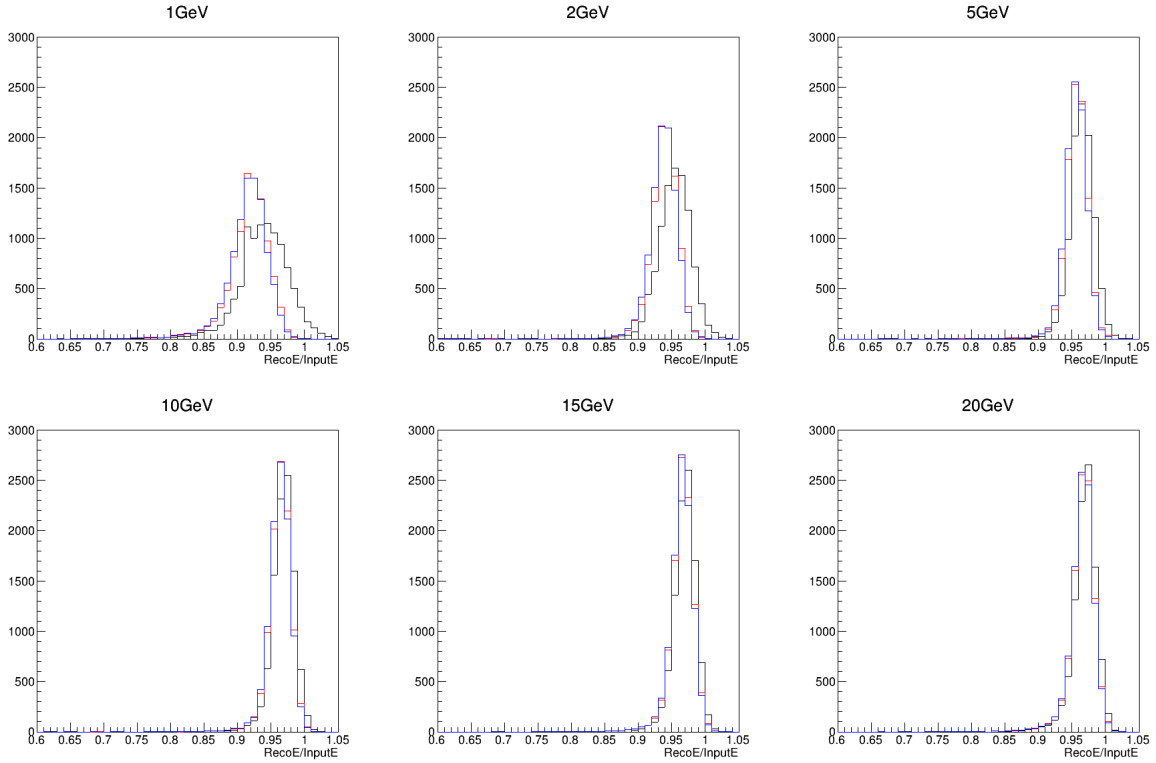
- Digital threshold value need to be scaled with the ADC resolution as analog noise didn't change with ADC resolution:

```
24          // threshold for firing
25          thresholdADC = m_cfg.thresholdFactor * m_cfg.pedSigmaADC + m_cfg.thresholdValue;
```

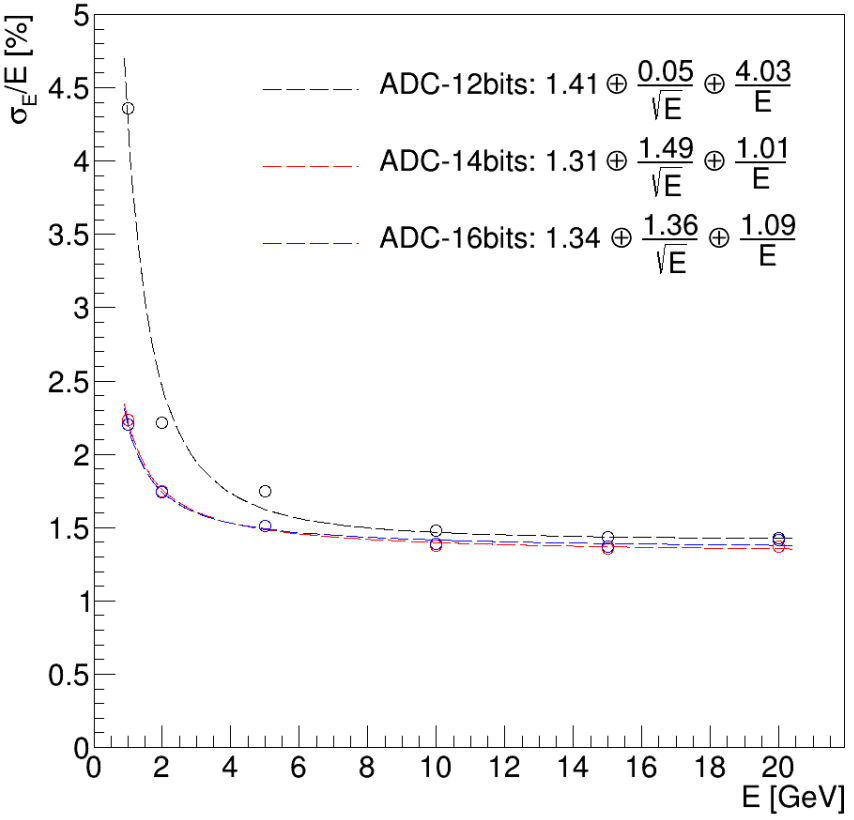


ADC resolution

Fit with the Gaussian

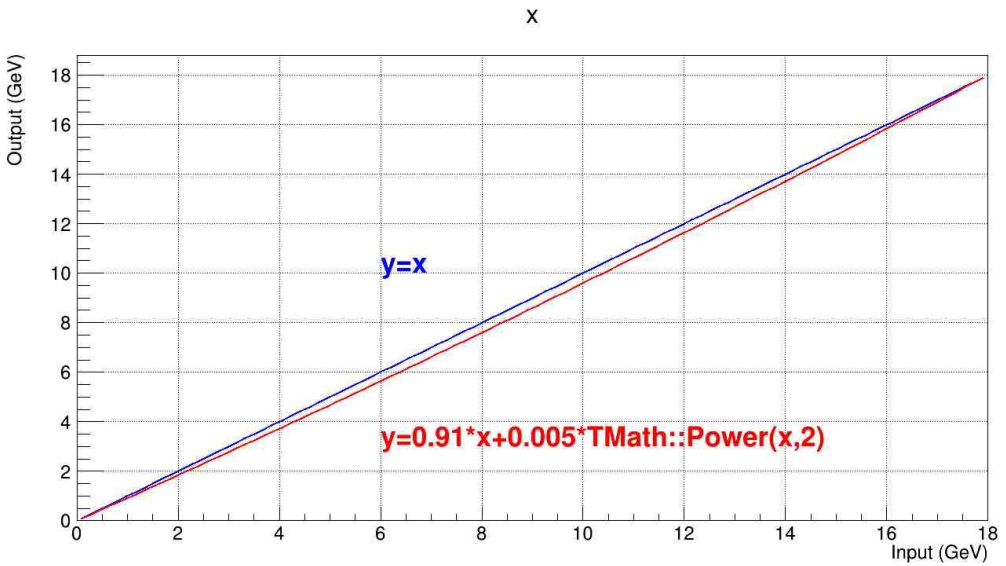


ADC-12 bits
ADC-14 bits
ADC-16 bits



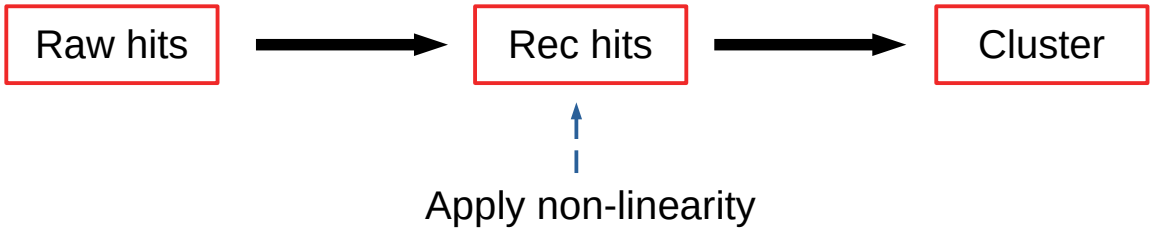
Conclusion:
14-bits would be sufficiently good for energy resolution

Non-linearity of the readout

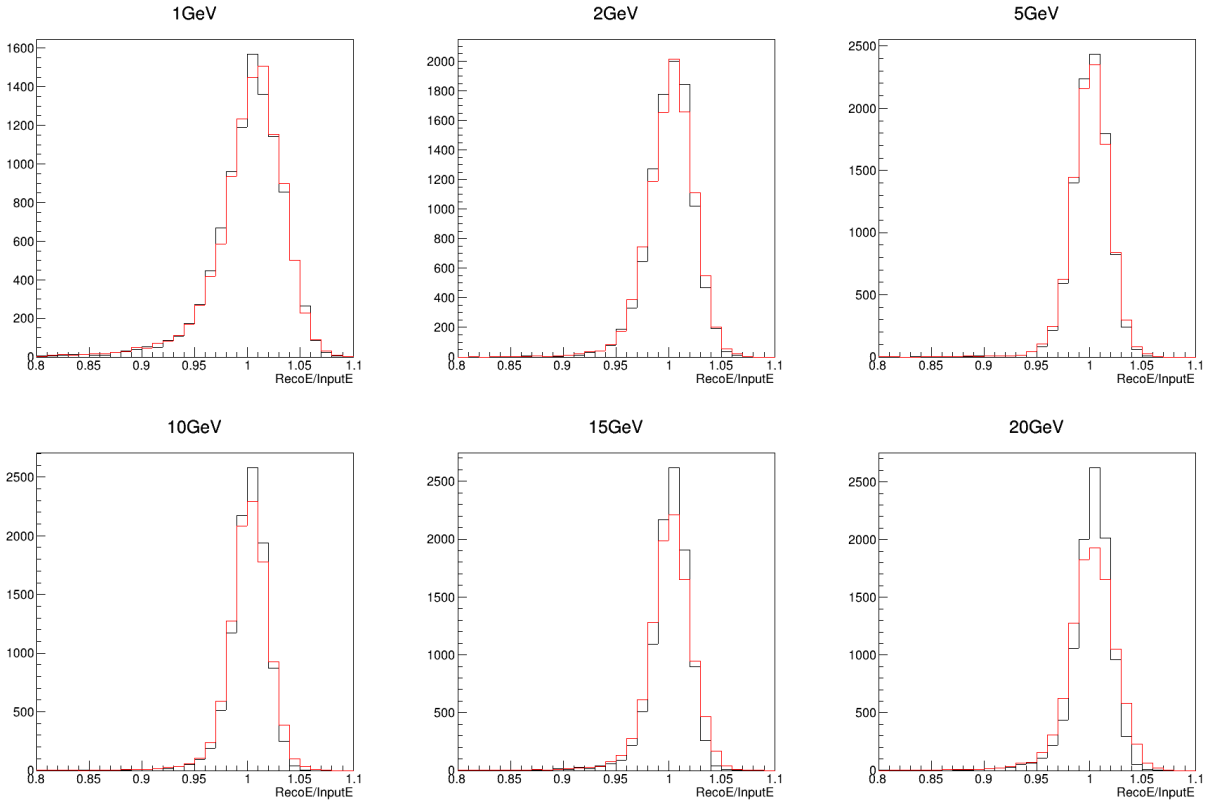


Non-linearity of electronics:
preamp, ADC...

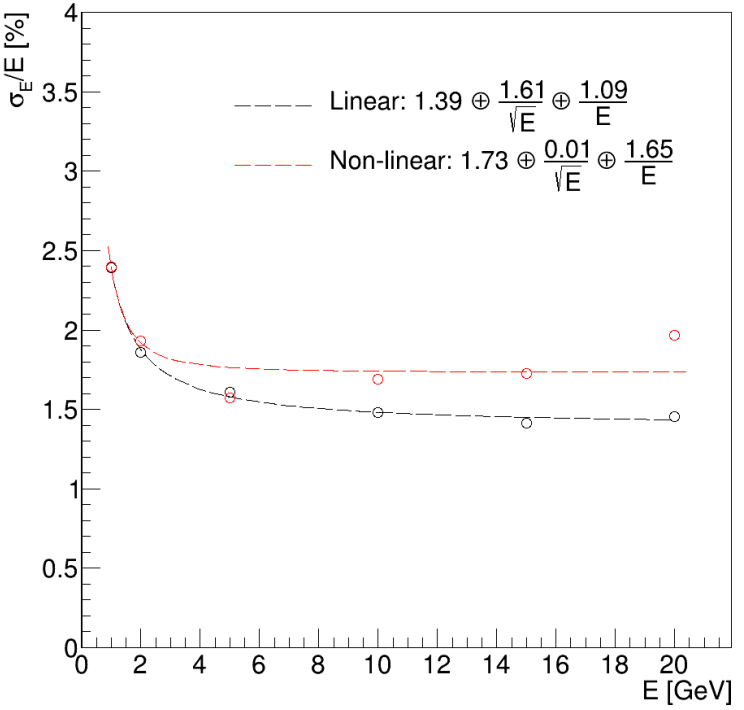
Default digitization:14bits



Non-linearity of the readout



linear
non-linear



Conclusion:
loss ~0.2% energy resolution for 0.5% non-linearity