A preliminary look at energies of VDG data at EM

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Outline

- Modification in tkrRecon which affects reconstruction of low energy gammas at EM
- Describe how energies of the gammas at EM were estimated
- Test the reconstruction method on various MC data
- Test the reconstruction method on VDG data
- Summary and plan

Possible modification in tkrRecon

Reconstruct VDG data, run 031007191651, 70304 events

Settings in TkrRecon: TkrControl.cxx

m_minEnergy = 30.0; // Min tracking energy (MeV)

m_fEneParticle = .8; // Fraction of Cal energy to use in PR.

Reconstruction settings	No of reconstructed events
Default settings: **m_minEnergy = 30** **m_fEneParticle = 0.8**	**39526**
Change settings: **m_minEnergy = 4** **m_fEneParticle = 1**	**60756**

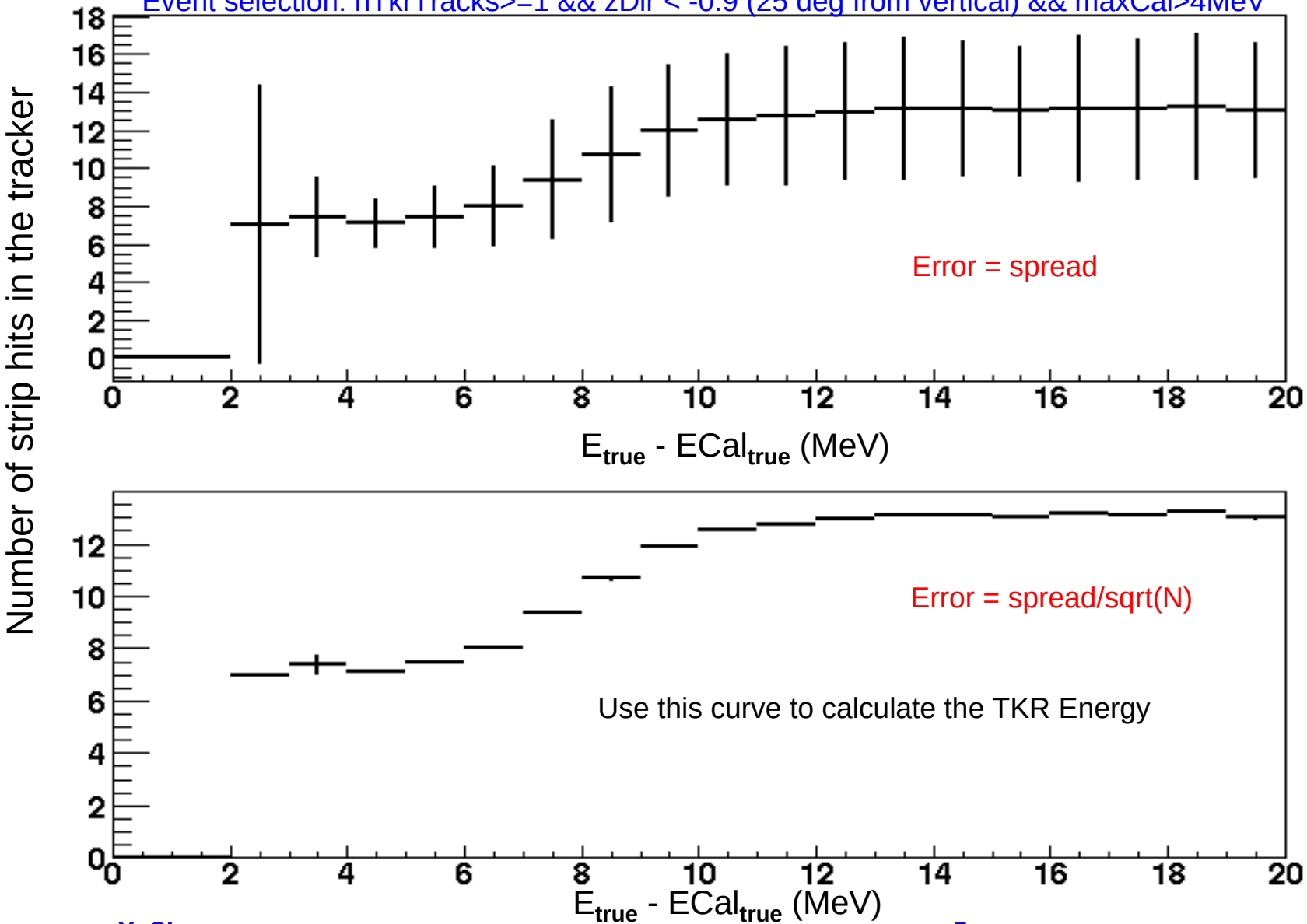
Threshold in CAL energy used in TkrRecon seems to be too high, especially for low energy gamma reconstruction. Can we change it to a low value? Need to investigate impacts for high energy gammas.

A simple way to estimate energy

- **Total estimated energy = TkrEnergy + CalEnergy**
  - **TkrEnergy is estimated according to number of hits in the tracker, corrected by the event direction**
  - **CalEnergy is estimated by summing up all calibrated energies recorded in each crystal. Need to correct for threshold effects since each crystal only "produces" an energy if it is > 2 MeV.**

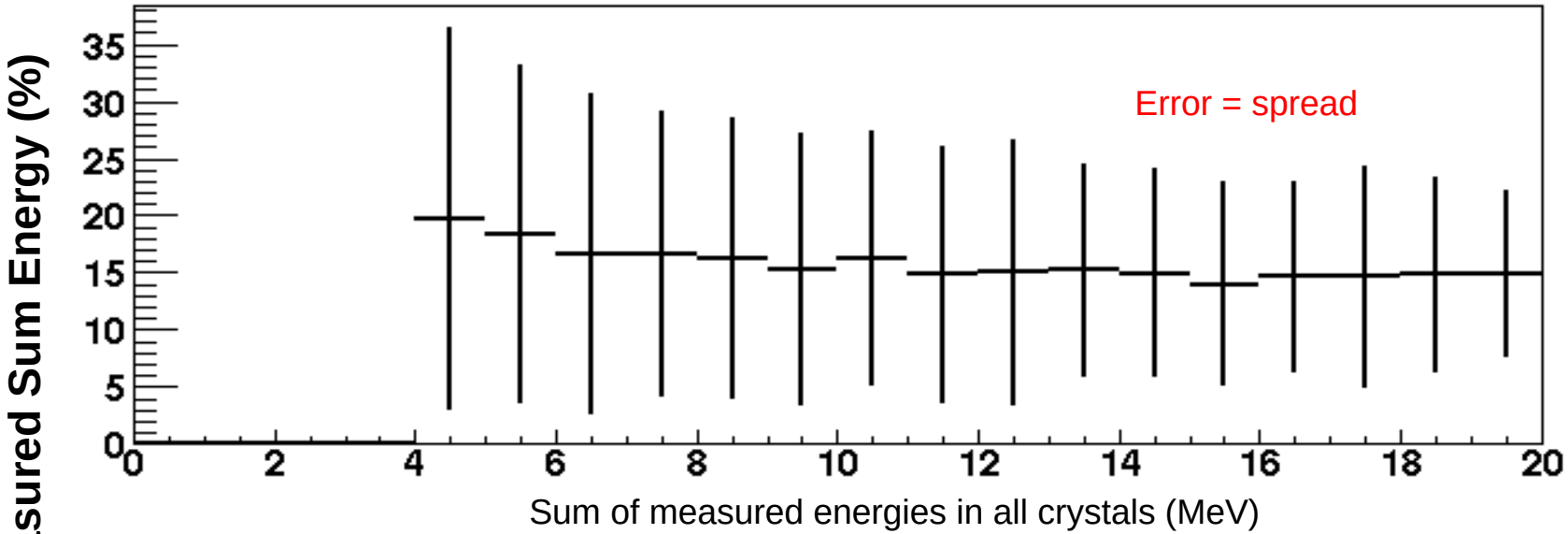
TKR Energy reconstruction (MC)

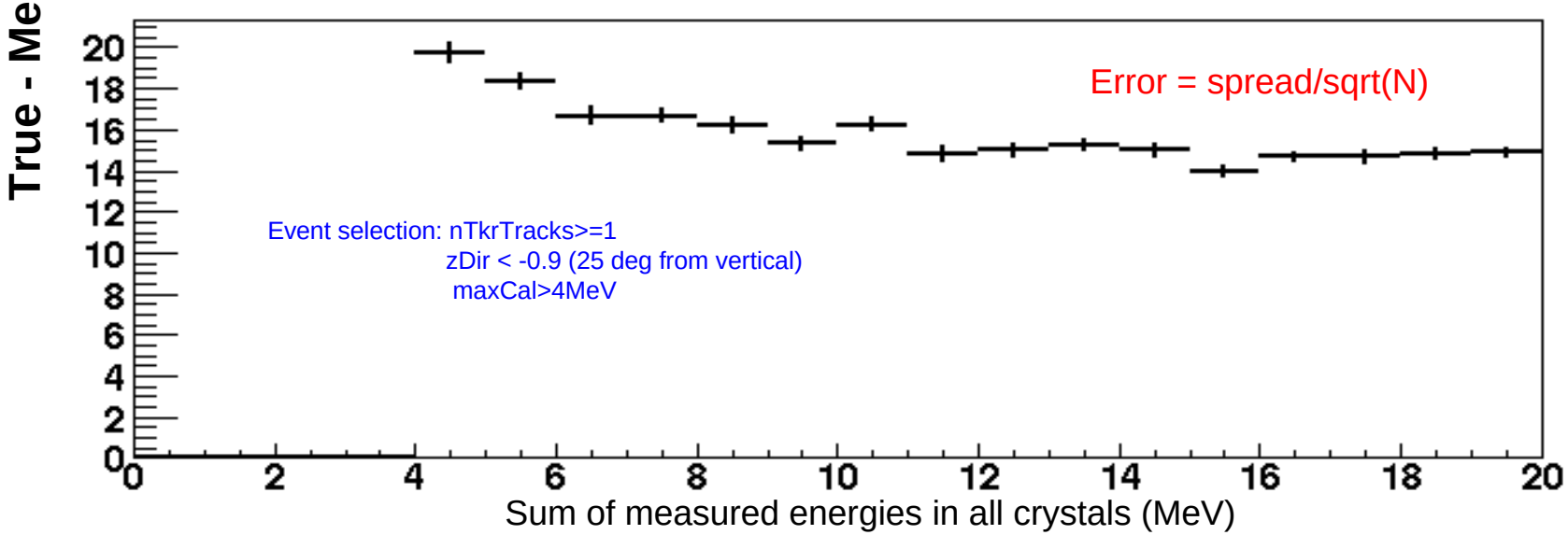
Event selection: nTkrTracks>=1 && zDir < -0.9 (25 deg from vertical) && maxCal>4MeV



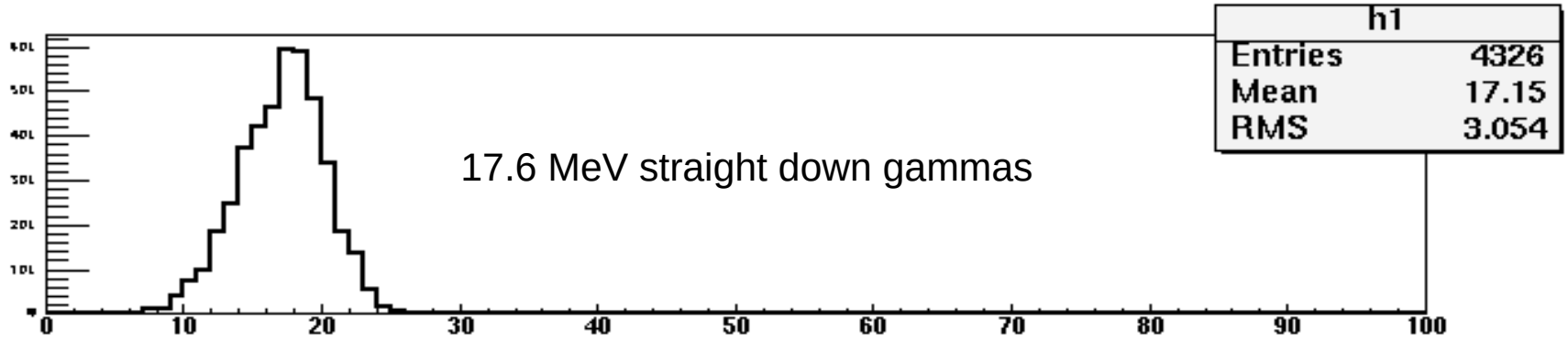
CAL Energy Correction (MC)

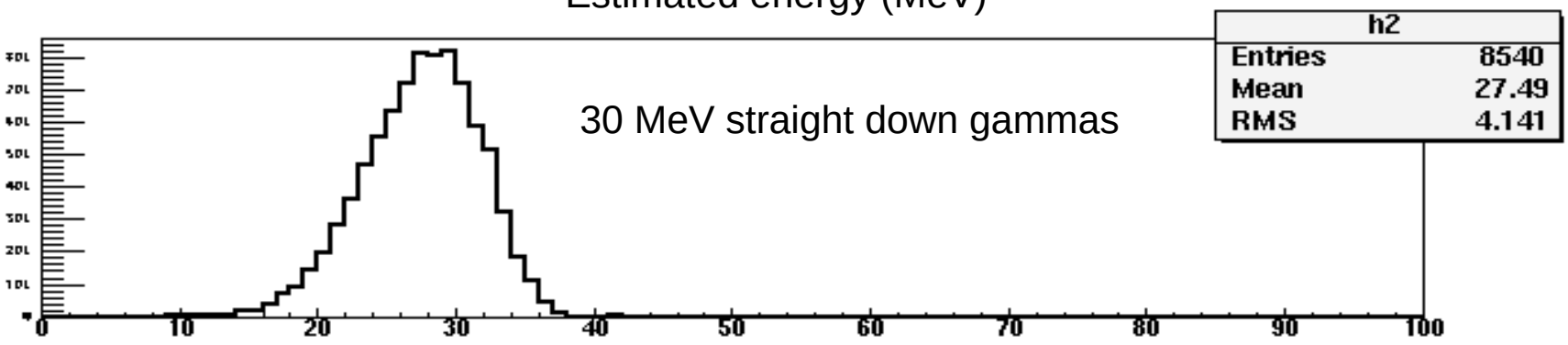
Threshold effect causes bias on measured CAL energy

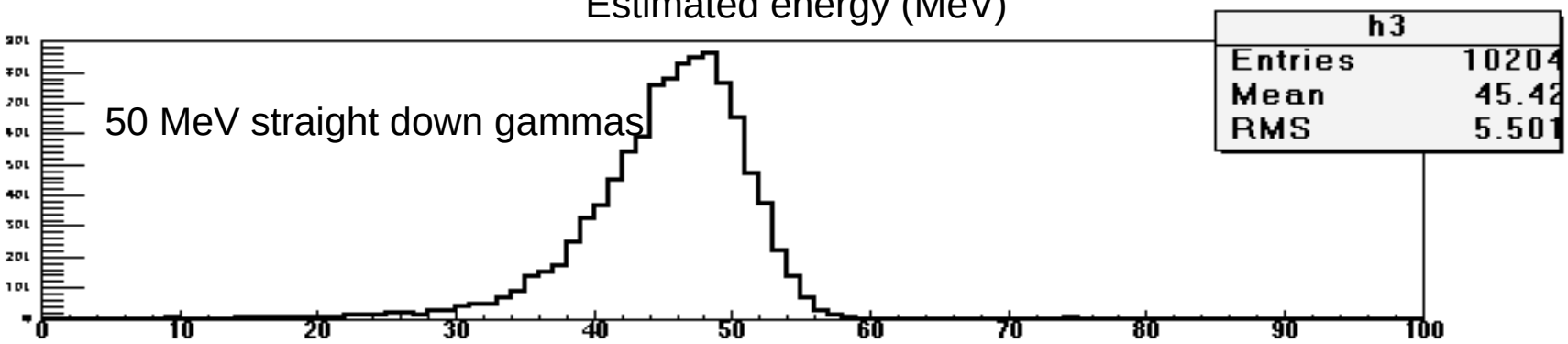




Test energy estimation on various MC data (monochromatic γ beam)

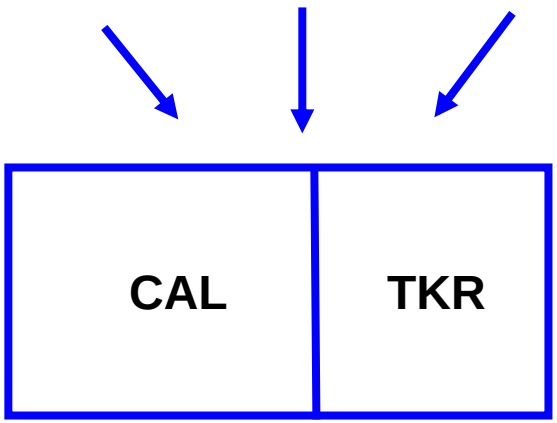






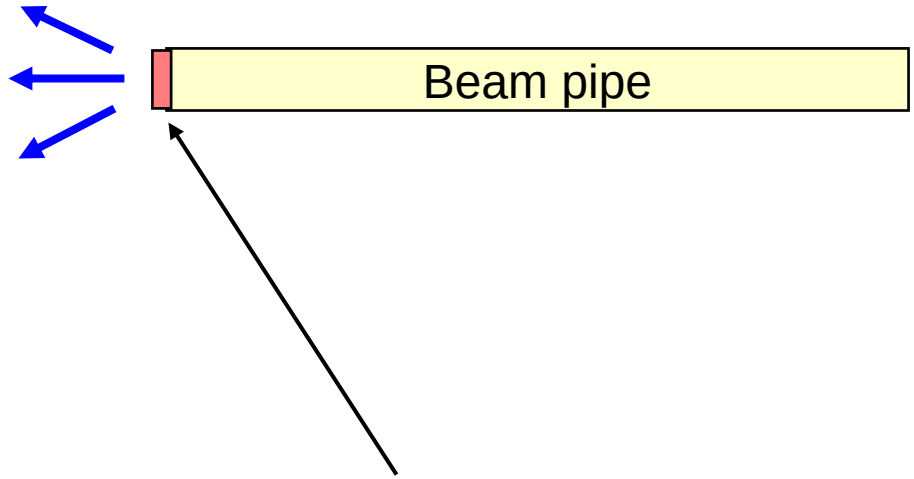
Experiment setup

Cosmic Background



Gammas:66% 17.6 MeV Not a monochromatic beam!
34% 14.6 MeV, FWHM = 1.5 MeV

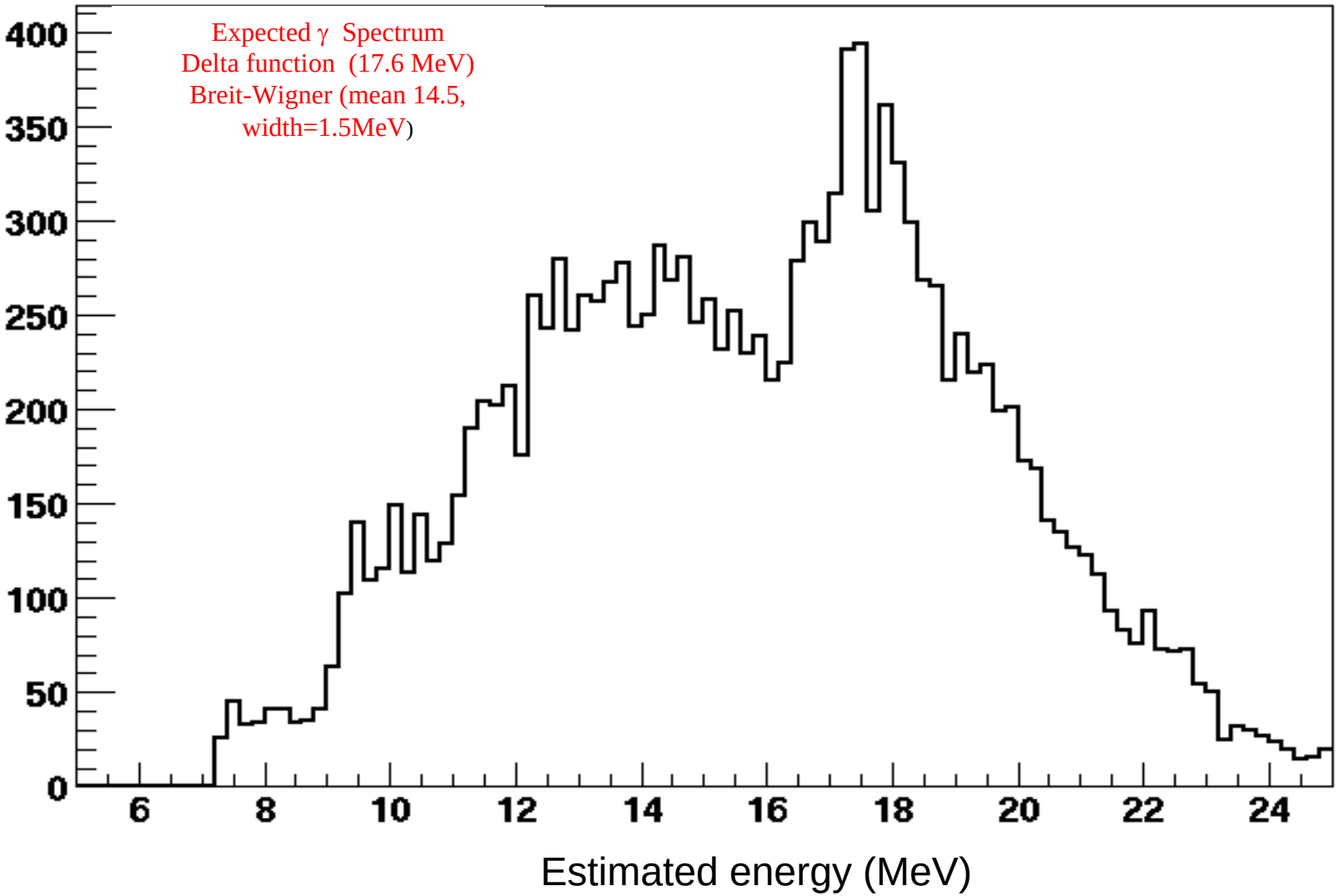
+ lots of electrons



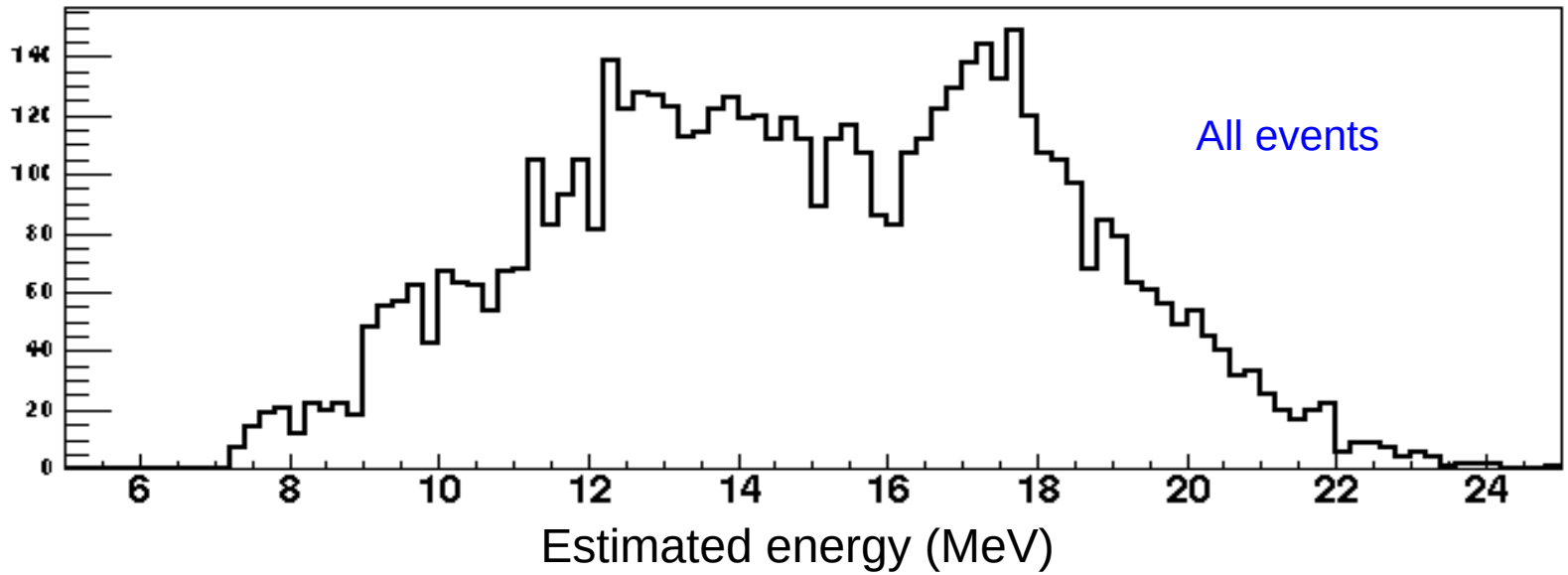
Electrons are produced by gamma conversions in the iron shield in front of the accelerator

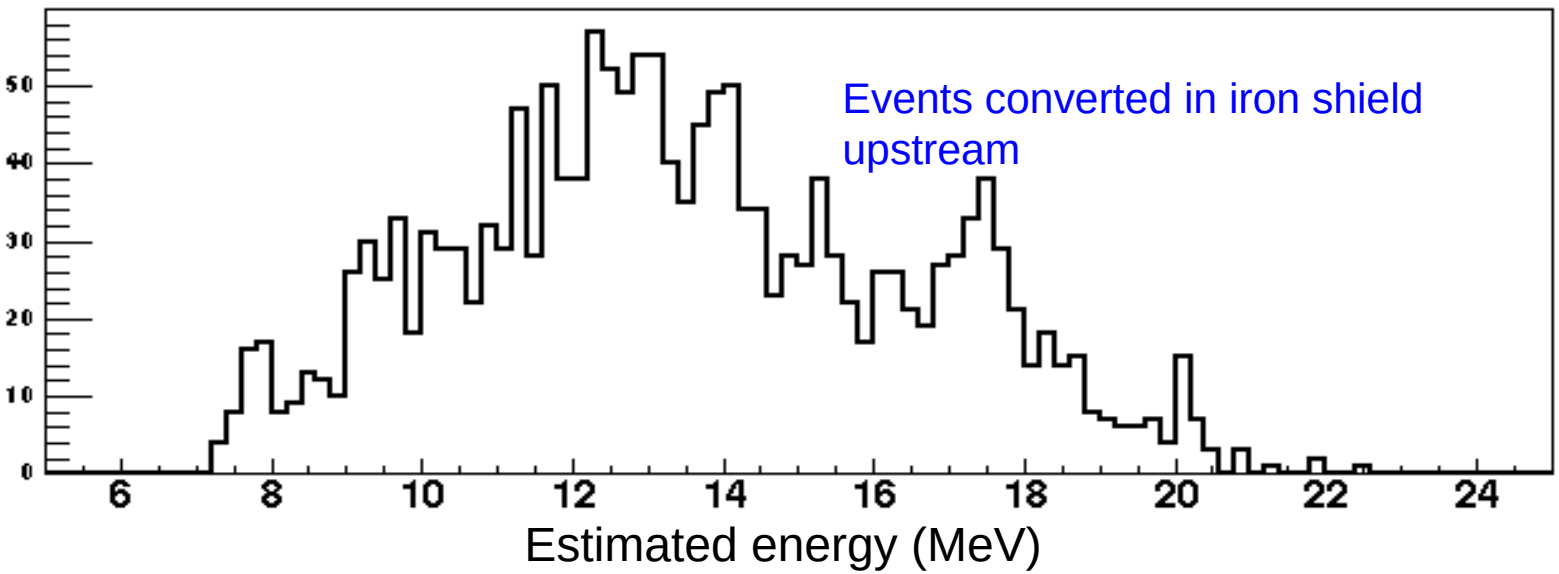
Reconstructed Energy Spectrum of VDG DATA

Event selection: nTkrTracks>=1 && zDir < -0.9 (25 deg from vertical) && maximal energy deposited in any single crystal>4MeV

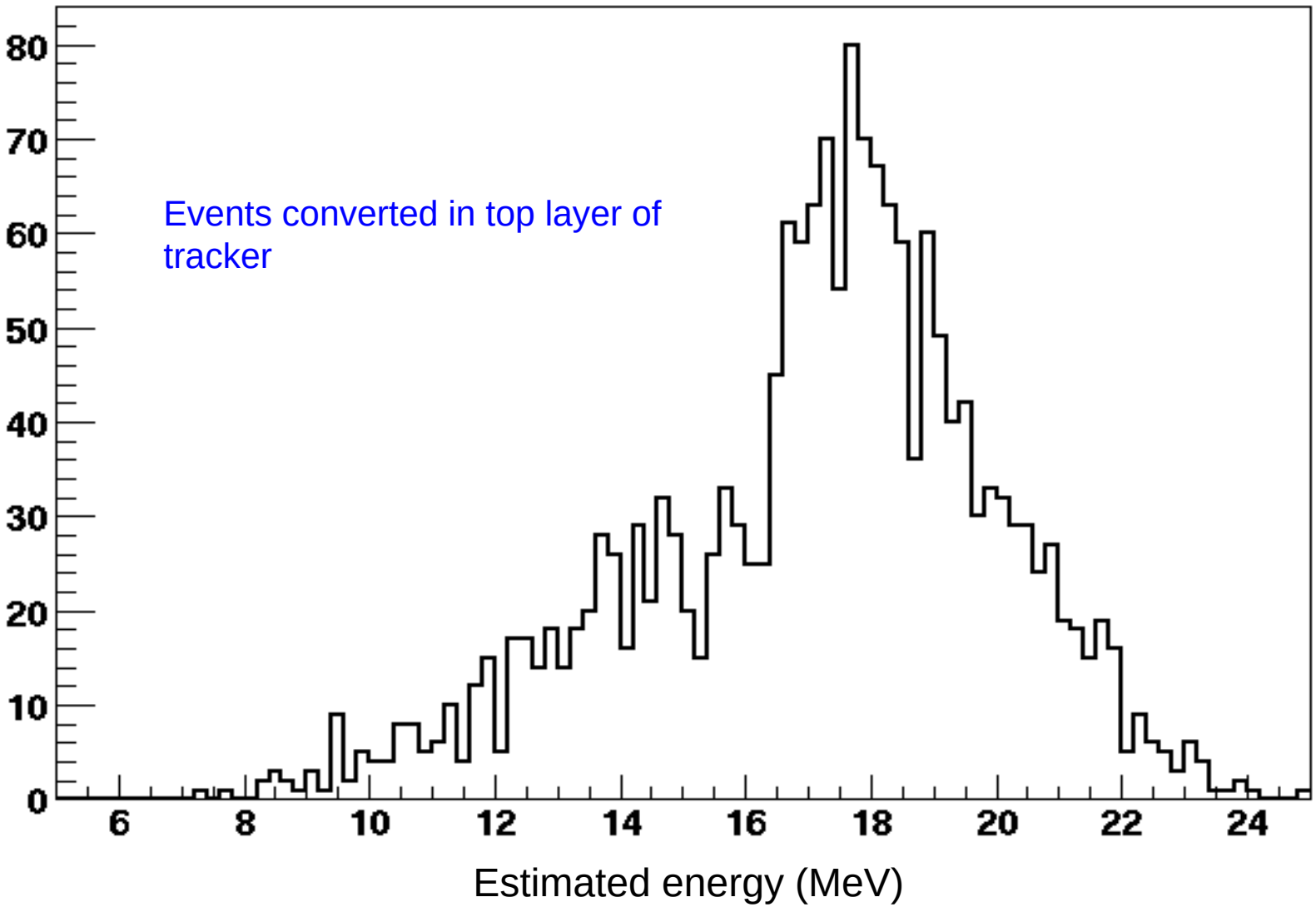


Reconstructed energy (MC VDG)





Reconstructed energy (MC VDG data)



Bias on the energy estimation

- **Potential reasons that fitted energy is a bit lower than known gamma energy**
  - **At least half of the signal is actually made of electrons produced upstream in the Fe shield**
  - **Some particles could deposit energy in inactive regions of the detector**
  - **Tracker loses sensitivity to high energy when nhits >= 12**
  - **Large uncertainty in calculating TKR energy**

Summary

- A simple energy estimator based on number of hits in the tracker and sum energy in all CAL crystals has been developed to reconstruct low energy gammas at EM
  - We have applied it on various MC and VDG data with reasonably good performances.
- VDG data generate lots of useful information to study performance of the EM, especially at low energy.

Future plan

- Following topics are under investigation:
  - Use multiple scattering to estimate tkrEne (KF result)
  - More parameters can be used to correct threshold effect in CAL such as number of hit crystals
  - Investigate off axis performance
  - Investigate full tower scenario
- Problems need to be solved in next EM data taking
  - Reject background electrons