Vetoing the high energy showers in the GRAPES-3 experiment whose cores lie outside the array

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On behalf of GRAPES-3 collaboration

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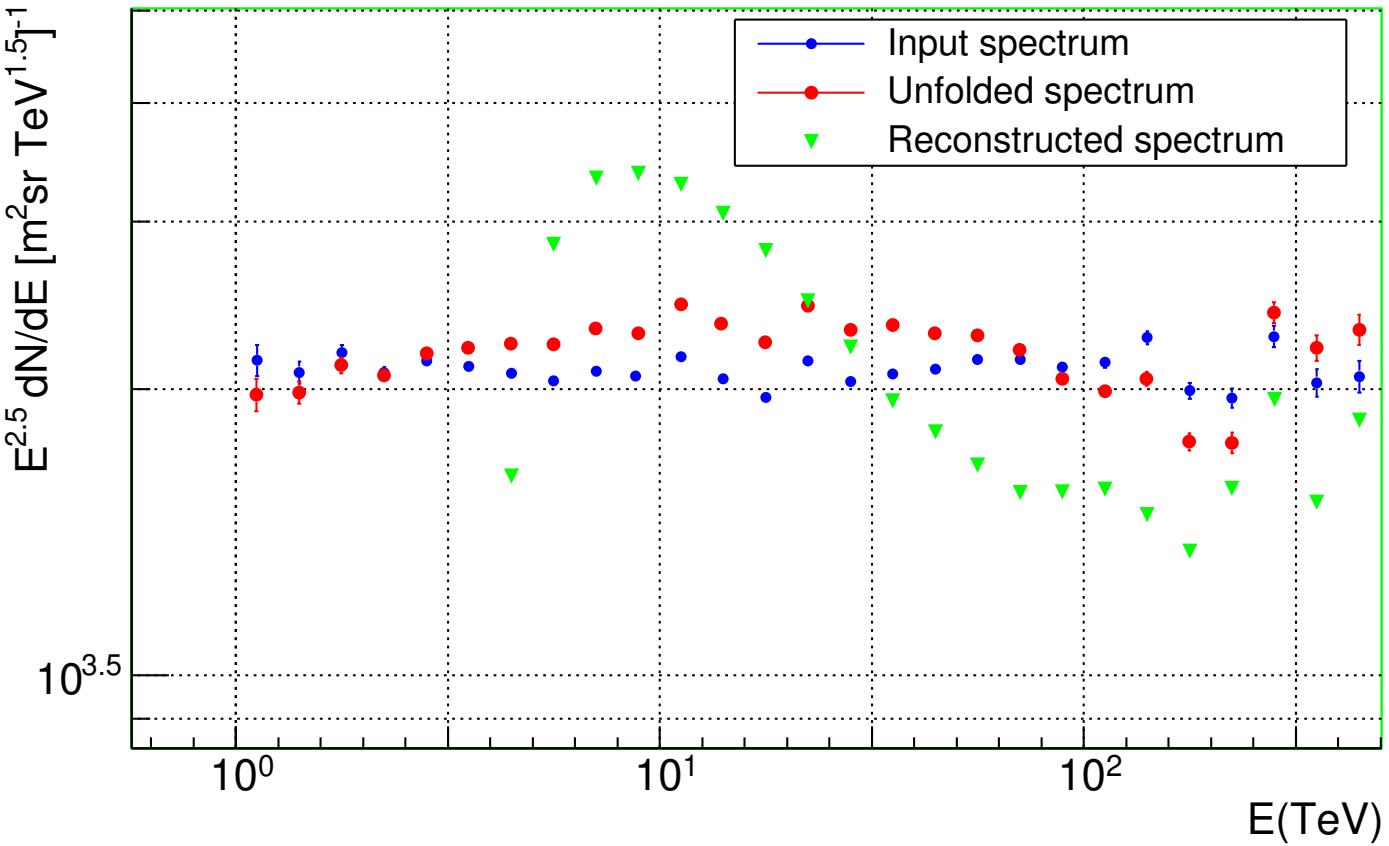
Motivation



Deviation from expected spectrum after unfolding.

Mis-reconstructed cores

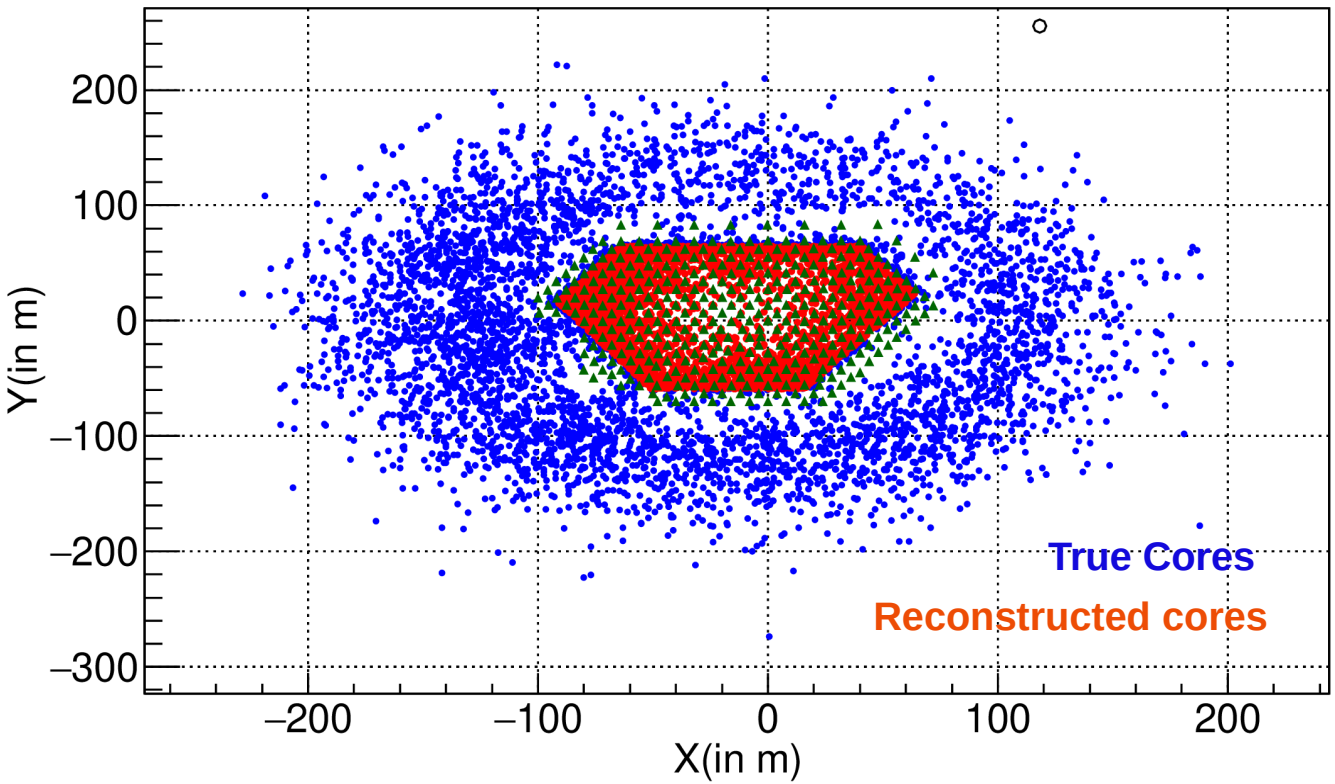
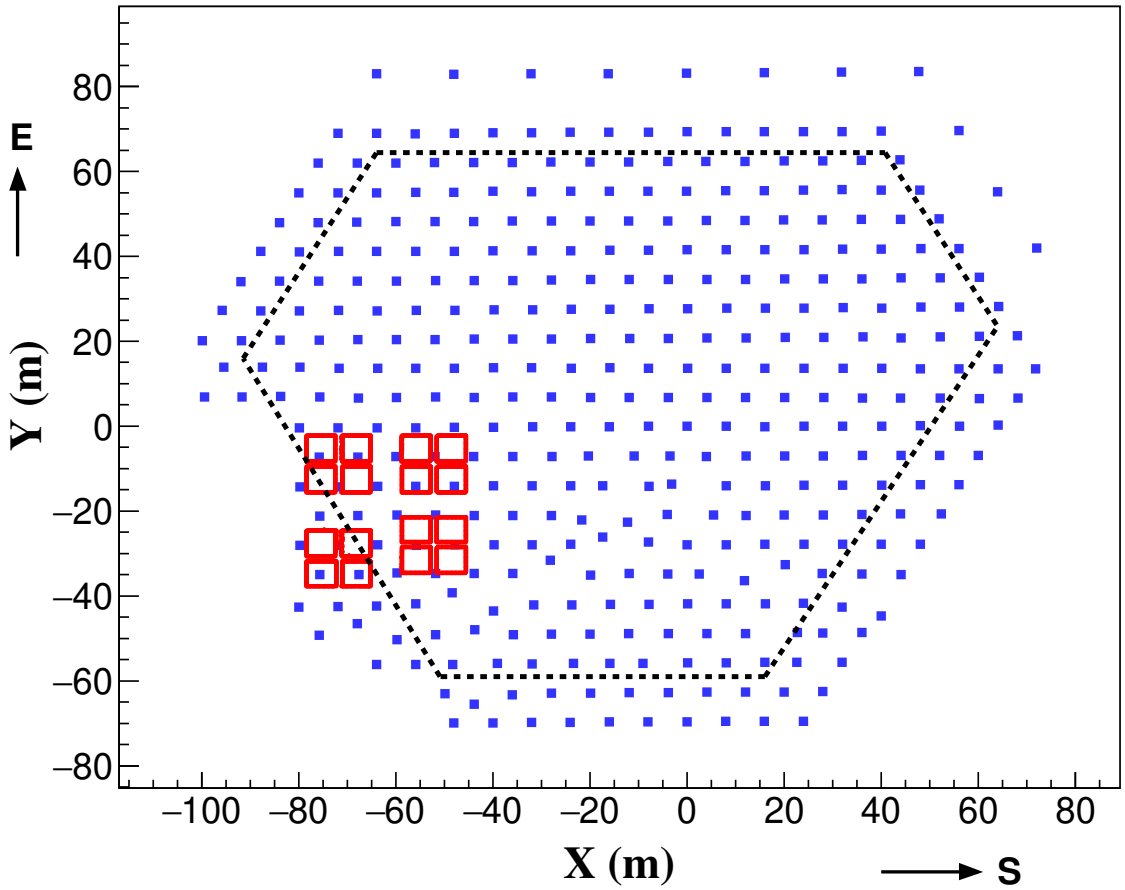


Figure: Mis-reconstructed shower cores for 100-158 TeV showers

The GRAPES-3 experiment



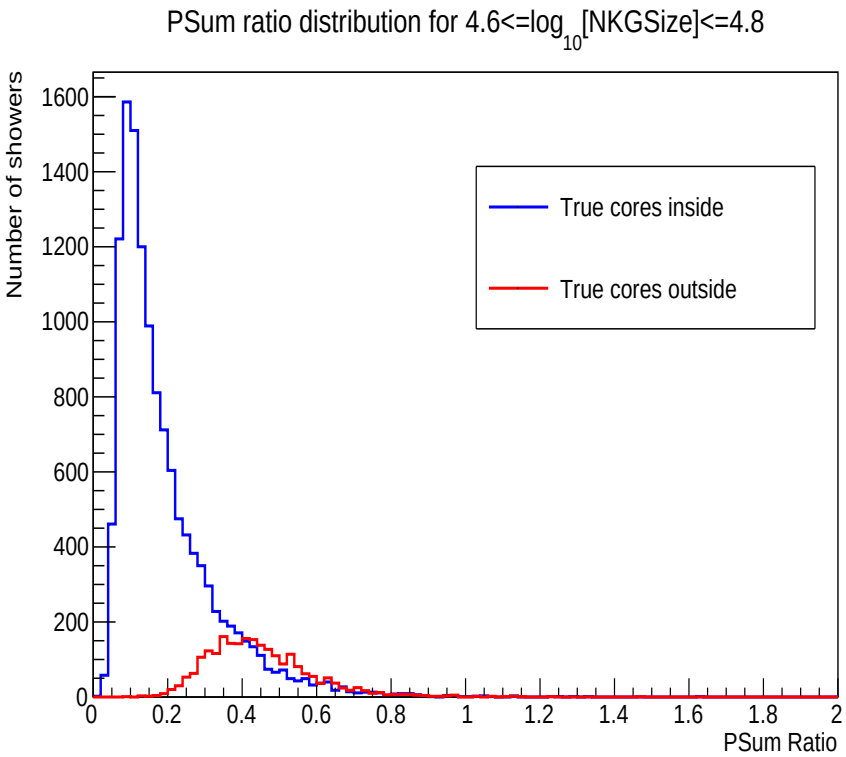
CORSIKA showers, Model: SIBYLL-FLUKA, Energy: 1 TeV - 10 PeV spectral index -2.5, Shower cores are thrown upto an area beyond which trigger fraction is less than 1%.

Variables

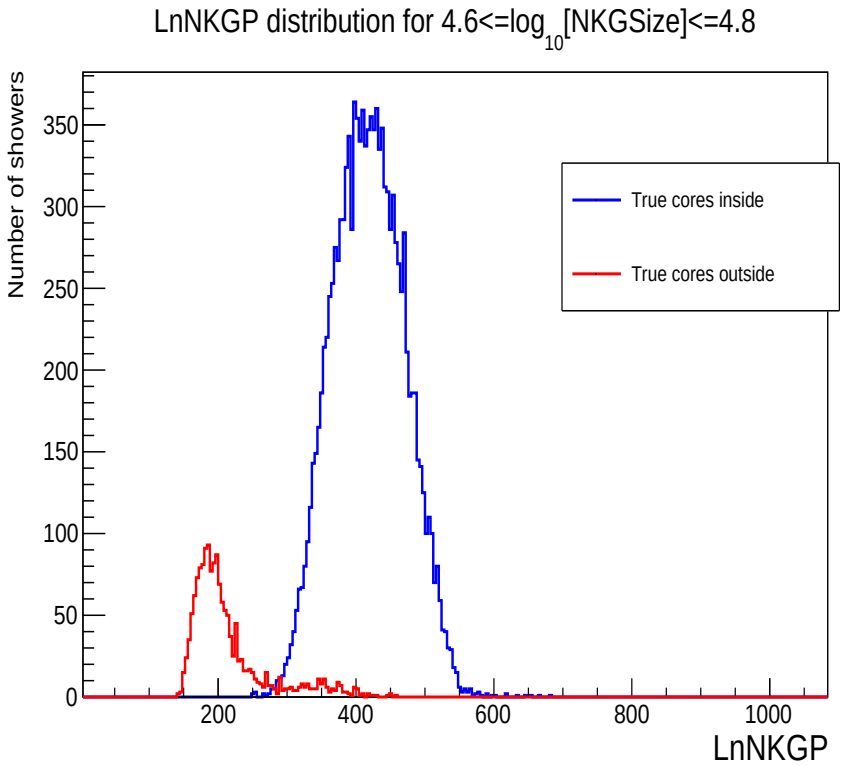
Simulated showers, detector response is calculated, fitted by NKG function to get shower size, age and core.
Showers with reconstructed cores within the fiducial area, $\theta \leq 25^{\circ}$.
mis-reconstructed: True cores outside fiducial area, Reconstructed cores inside, well-reconstructed : Both true and reconstructed cores inside.

1. PSumRatio: $PSumRatio = PSumOut/PSumIn$
   PSumIn: Sum of particle densities inside fiducial area
   PSumOut: Sum of particle densities outside fiducial area
2. LnNKGP : best functional value obtained for negative log likelihood function used for NKG fit. Describes quality of NKG fit.
3. Age : Developmental stage of shower, obtained from NKG fit
4. Age err : Error on Age parameter
5. ChiSq1 : ChiSq1 of the planar fit for direction reconstruction

Variables, $4.6 \leq log_{10}[NKGSize] \leq 4.8$



(a) PSumRatio

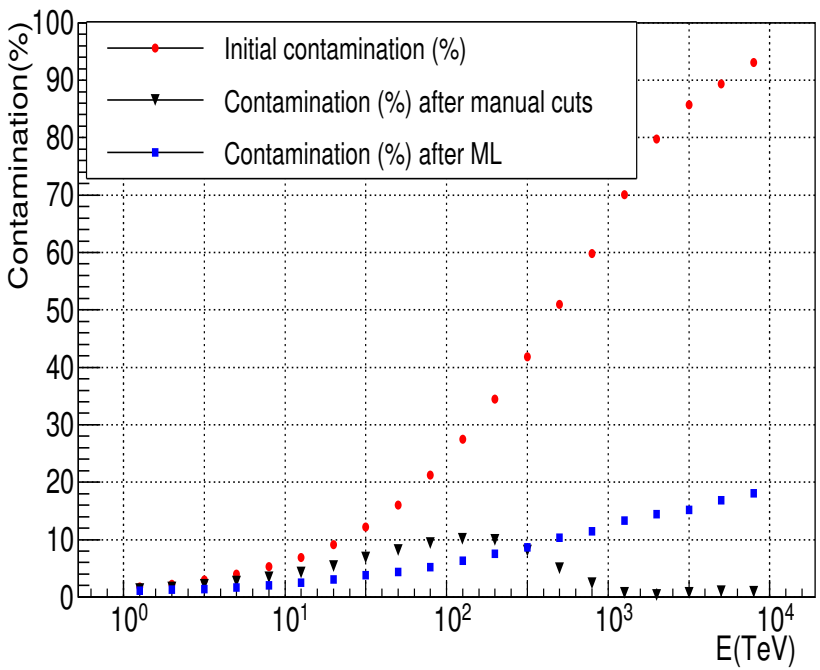


(b) LnNKGP

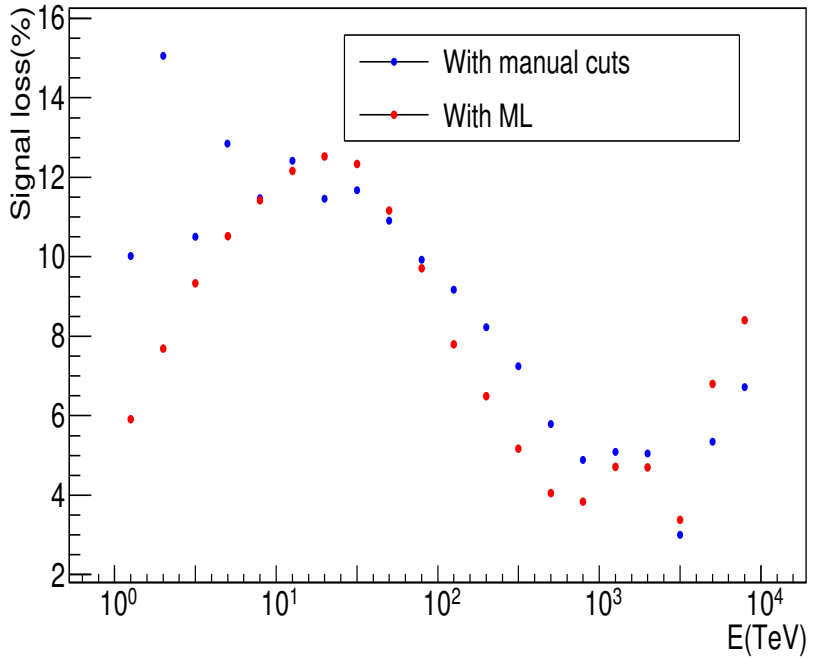
Cuts developed manually as well as using machine learning.

Reduction of contamination

Contamination $100\% * B/(S+B)$, B: True cores outside but reconstructed cores inside, S: Both true and reconstructed cores inside.



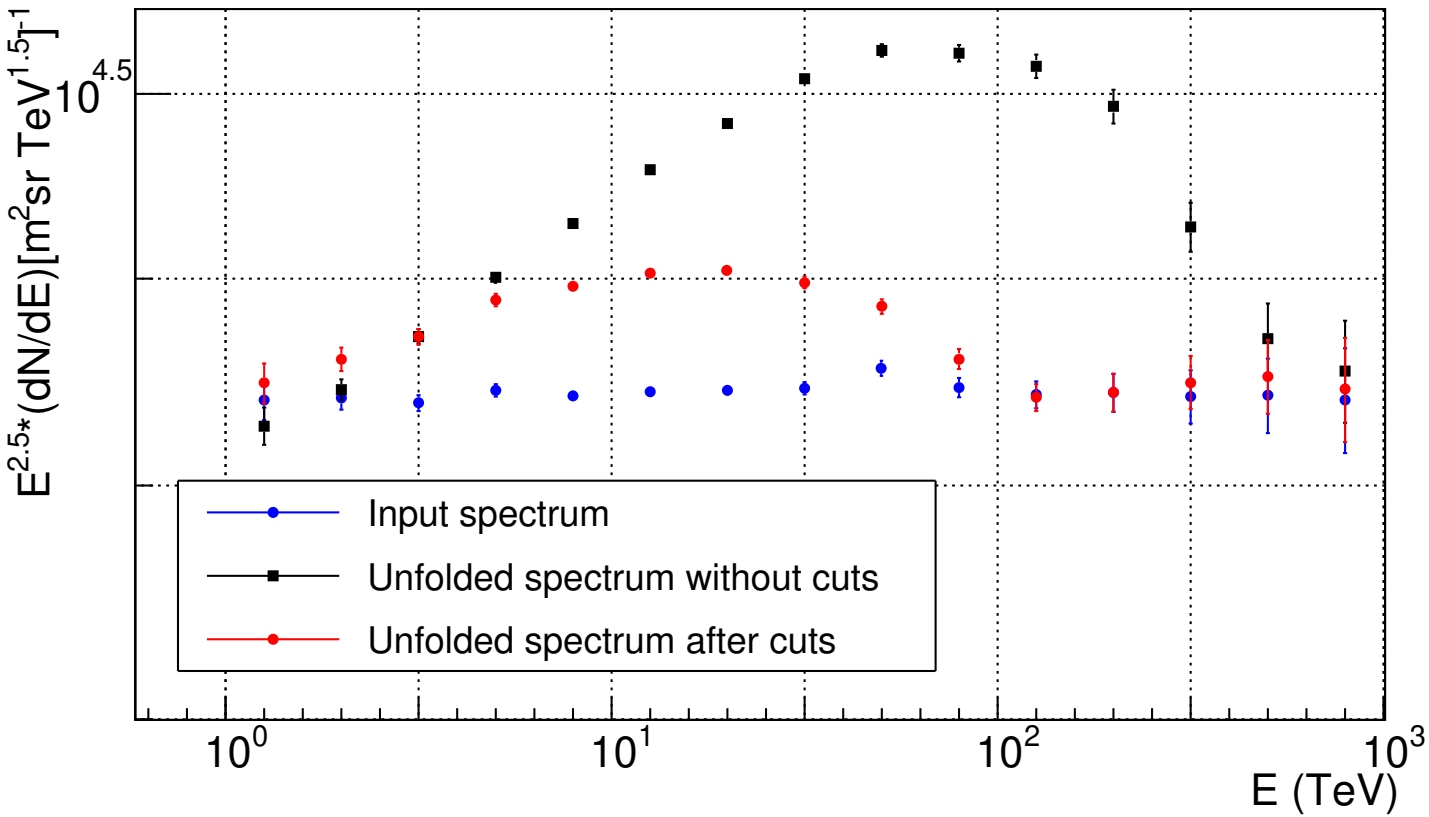
(a) Contamination (%) (Preliminary)



(b) Signal loss (in %) (Preliminary)

Improvements in energy spectrum

$\theta < 25^\circ$, Using manual cuts (Preliminary)



Deviation decreases.

Summary and future work

- Improvement of energy spectrum by developing quality cuts to remove mis-reconstructed showers
- Furthur improvements on the results will be tried