Istituto Nazionale di Fisica Nucleare
SEZIONE DI FIRENZE

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Current analysis using GGS – EventAnalysis -HerdSoftware

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List of current analysis

- Analysis which are already implemented using the framework:
  - Trigger efficiency and expected trigger rate:
    - J. Casaus, F. Giovacchini, M.A. Velasco (Madrid), A Oliva (Bologna)
  - Evaluation of back-scattered particles which hit the PSD:
    - Peng Hu, Fabio Gargano (Bari)
  - Acceptance measurement and preliminary electron energy resolution:
    - Lorenzo Pacini (Firenze)
- Analysis which will be use the framework (these are not discussed here):
  - FIT capability of measuring photons, Léa Jouvin (Barcelona)
  - Charge resolution of SCD, Alberto Oliva (Bologna) [See HERD work-shop, Xi'an 2019]

This presentation is not meant to discuss about analysis details.

The main purpose is to show the usage of the common software inside relevant analysis

Trigger efficiency and expected trigger rate.

J. Casaus, F. Giovacchini, M.A. Velasco (Madrid) ,

A. Oliva (Bologna)

See HERD work-shop, Xi'an 2019

Simulation and trigger definition

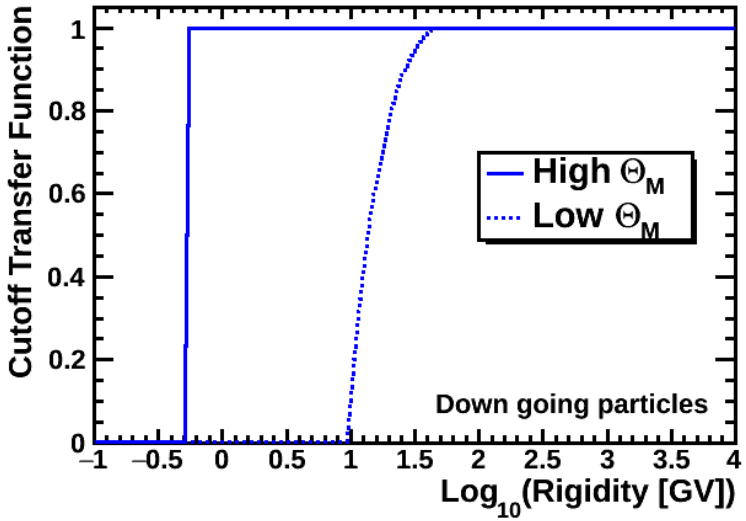
- MC production using GGS and Herd parametric geometry in HerdSoftware
- Protons, electrons, gamma and helium nuclei at ~30 fixed energy points logarithmically spaced ranging from 0.1 GeV to 8.2 TeV
- (1-3)x10^6 particles per particle species and energy point generated isotropically from a hemisphere containing the detector volume
- Trigger logic applied to output files after digitization with EventAnalysis

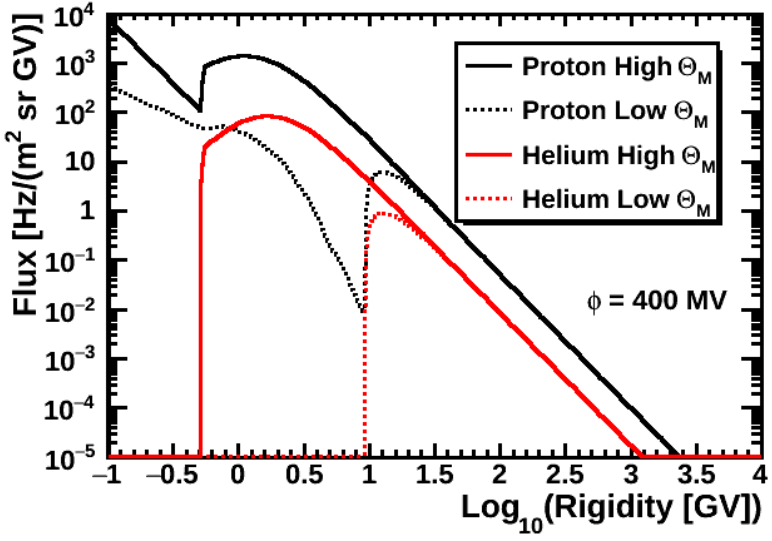
The Global Trigger (GT) is obtained from the logical combination of the particle-dedicated sub-triggers, built from the deposited energies in CALO and PSD

- HE (High Energy particle) requires high energy deposition in CALO (core)
- LEG (Low Energy photon) low energy deposition in CALO (shell) and PSD veto
- LEE (Low Energy Electron) low energy deposition in CALO (shell)
- Unbiased: low energy in CALO, for trigger efficiency evaluation
- Calibration Trigger: low energy deposition in CALO.

Particle fluxes approximation

- GCR from GALPROP subject to solar modulation and Earth rigidity cutoff
- Under cutoff secondary particles obtained from AMS-01 measurements
- Lookup tables containing the individual particle fluxes on a grid of orbit positions for solar MIN and MAX have been produced. Only Results for solar MIN are presented
- A geomagnetic cutoff differential transfer function for down going particles is obtained for each orbit position and applied to GCR flux



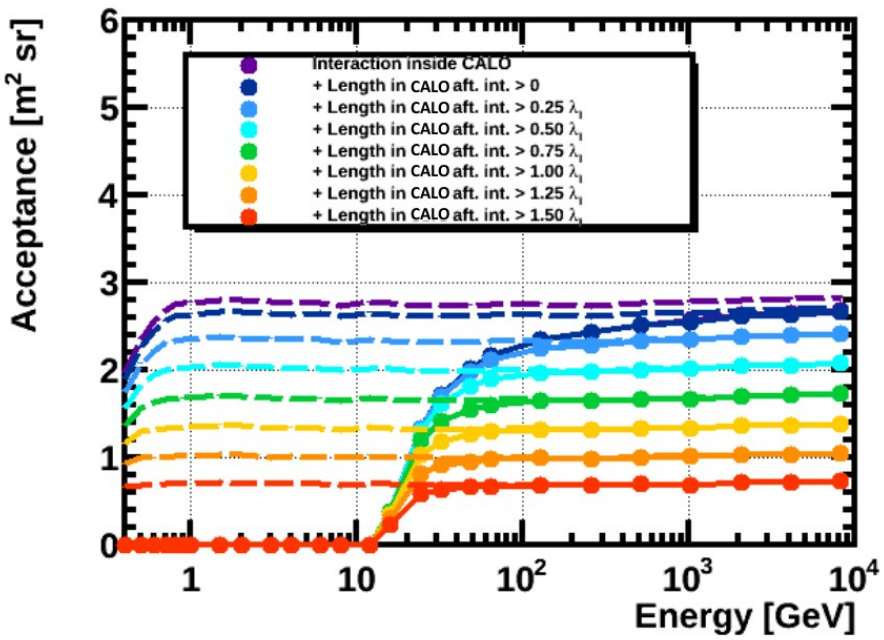


Results

Trigger rate

	p+He Ave.(Max.)	proton Ave.(Max.)	helium Ave.(Max.)
▪ HE [Hz] :	54 (55)	38.6 (39.0)	15.4 (15.9)
▪ LEE [Hz] :	37 (120)	30.3 (95.2)	6.2 (24.5)
▪ LEG [Hz] :	1.2 (7.1)	1.0 (5.9)	0.2 (1.2)
▪ Unb. [kHz] :	1.6 (4.8)	1.3 (3.9)	0.3 (0.9)
▪ Global [Hz] :	92 (179)	70.2 (138)	21.9 (41.3)
▪ Calib. [Hz] :	38 (101)	35.7 (95.8)	1.8 (5.0)

Acceptance with HET vs proton shower length



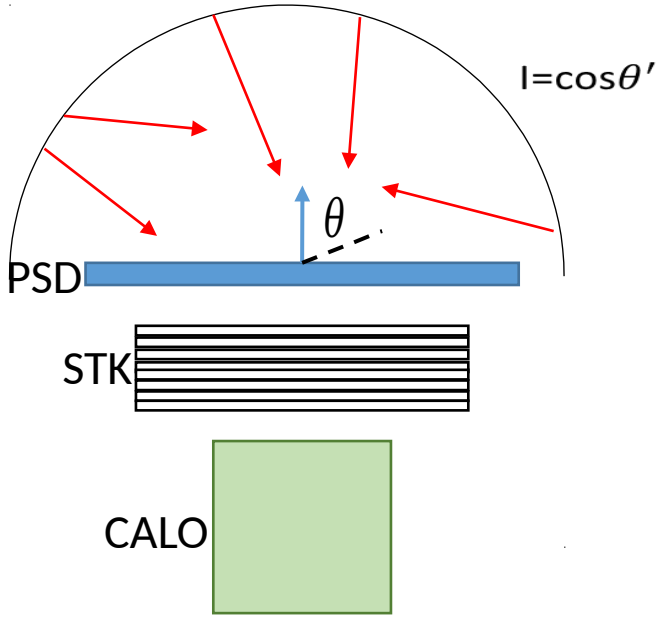
The next step will consist in integrating the trigger logic inside HerdSoftware to provide the event-by-event trigger output

Evaluation of back-scattered particles which hit the PSD

Peng Hu, Fabio Gargano (Bari)

Simulation

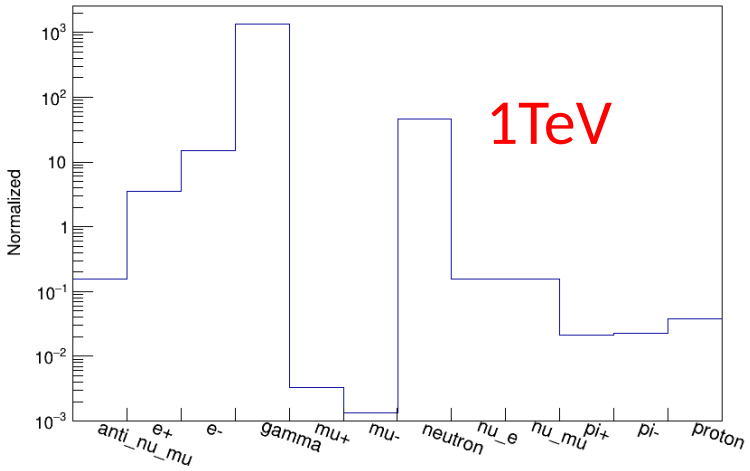
- Geomerty(HerdSoftware)
  - Tile&top psd thickness = 1cm
  - caloTopStkDistance = 12cm
  - topPsdTopStkDistance = 12cm
  - all sub-detectors are activated
- Particle(GGS Particle Gun)



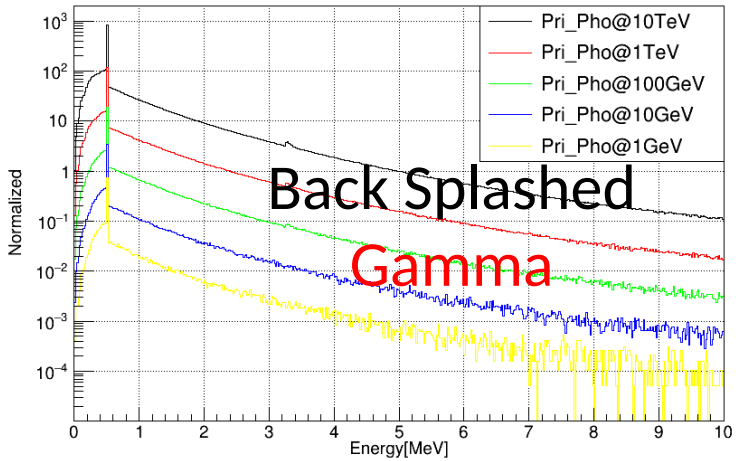
Gamma: identical intensity within top psd acceptance(theta from 90-180 deg relative to top psd normal),energy from 500MeV to 50GeV

Back-scattered particles.

BS Particle Type



BS Particle Energy Dis



Using:

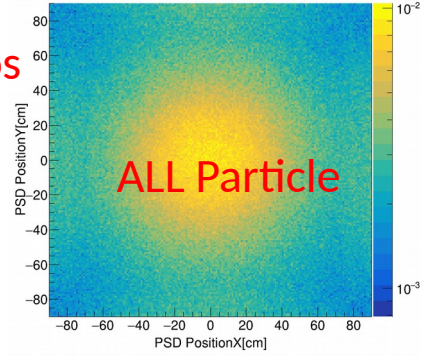
Event Analysis and

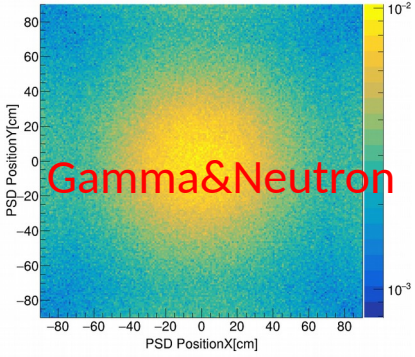
HerdSoftware data-model

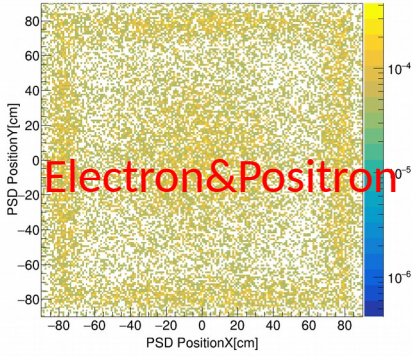
BS Particle HitPos

Primary Photon

@100GeV





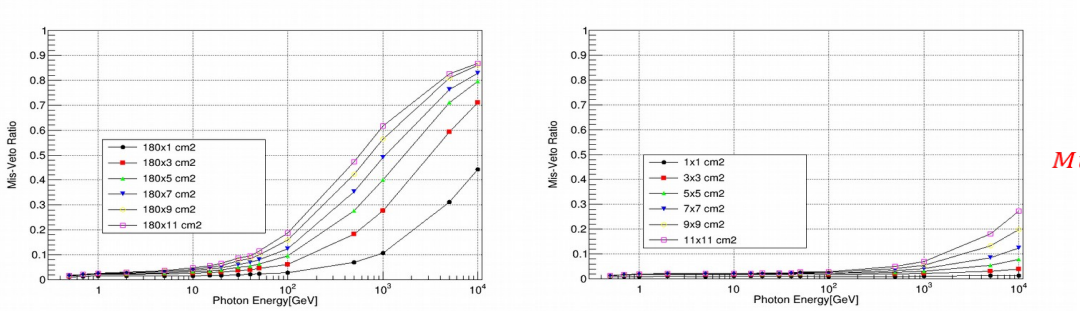


Preliminary results

CaloCell_Fire_Threshold > 1/3 LYSO MIP
Shell_Trig_Threshold > 350MeV
Core_Trig_Threshold > 10GeV

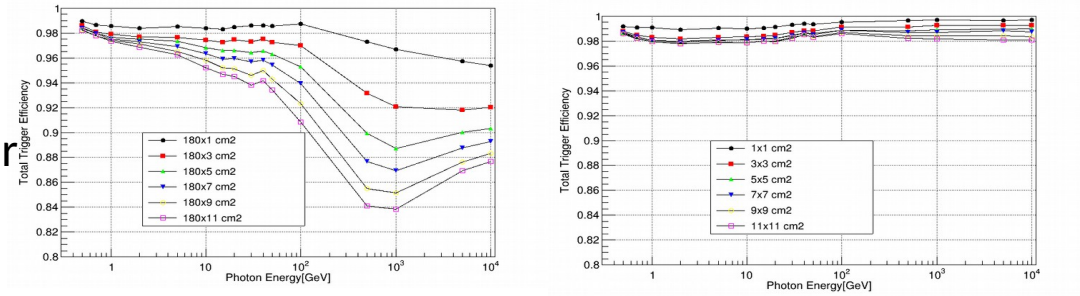
LE_Trig=Shell_Trig&&(!Veto)
HE_Trig=Core_Trig

Mis-Veto Ratio



$$MisVetoRatio = \frac{N_{[Cross\_psd\&\&(Shell\_Trig||Core\_Trig)\&\&Veto]}}{N_{[Cross\_psd\&\&(Shell\_Trig||Core\_Trig)]}}$$

Total Trigger Efficiency



$$TotalTrigEff = \frac{N_{[Cross\_psd\&\&(LE\_Trig||HE\_Trig)]}}{N_{[Cross\_psd\&\&(Shell\_Trig||Core\_Trig)]}}$$

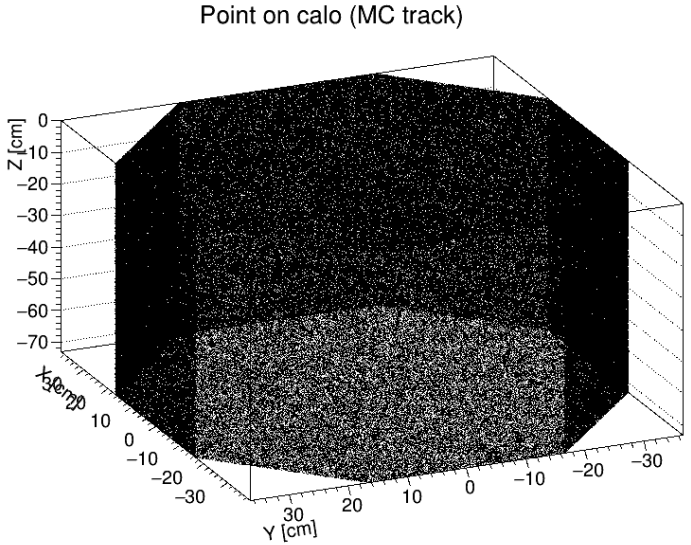
Acceptance measurement and preliminary electron energy resolution

Lorenzo Pacini (Firenze)

See HERD work-shop, Xi'an 2019

Completely integrated inside the common software.

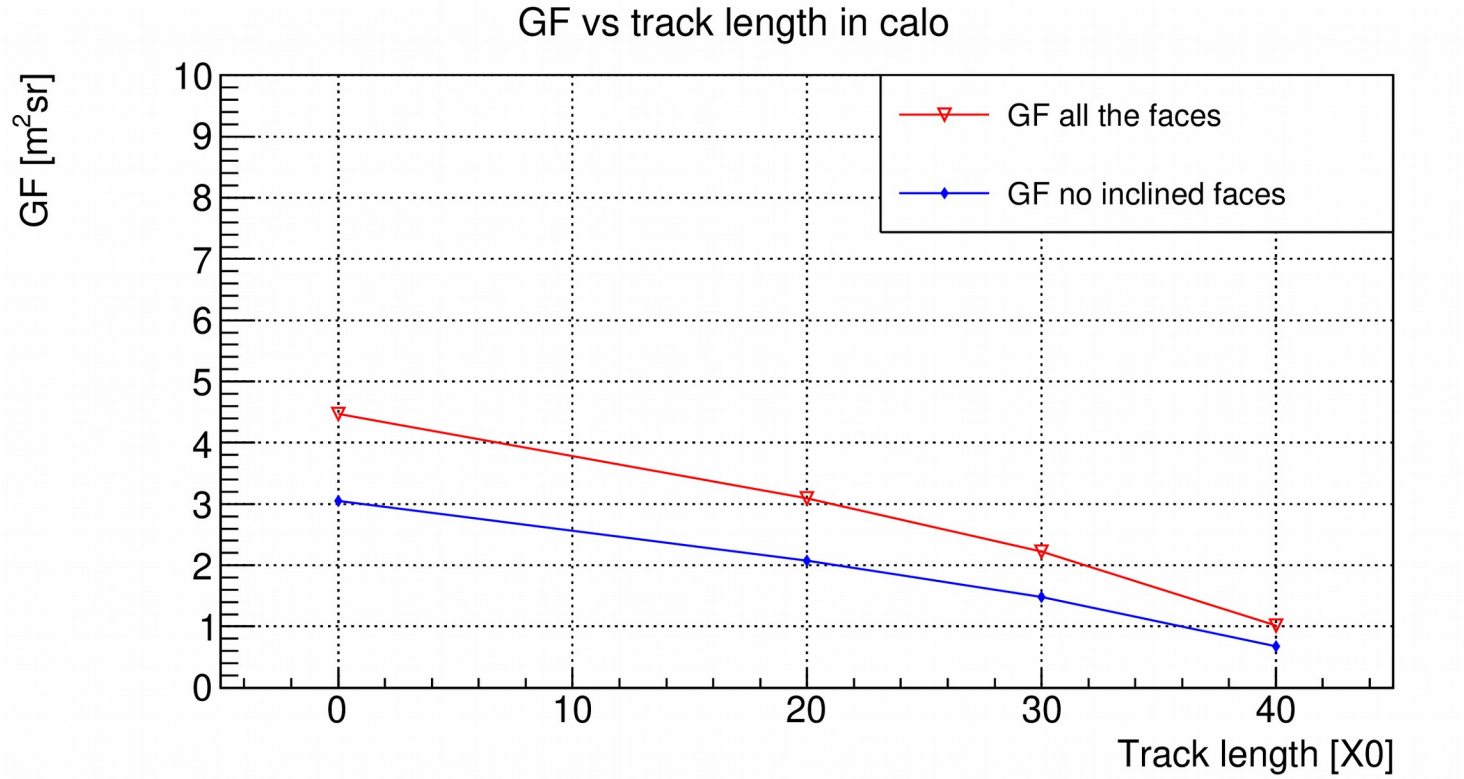
Simulation and analysis



- Using HerdSoftware standard geometry (Calo+Stk+Psd)
- Using GGS to simulate geantion particles
- 10 planes define the calo surfaces.
- STK geometry is also takes into account.
- A particle is in acceptance if:
  - The track intersects a Calo surface, excluding the bottom surface.
  - The track length in the Calo is $>$ of a given threshold (X0).
  - The number of intersections between the true track and the STK planes are $>$ thresholds
  - Particle with a polar angle $>$ Theta_Max deg are rejected.

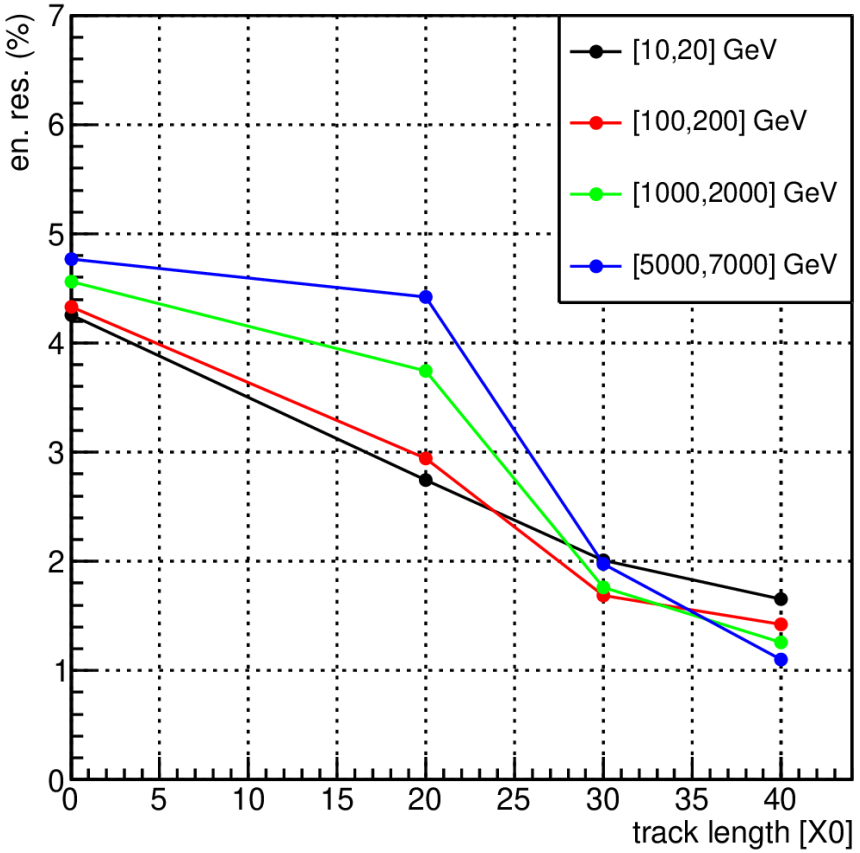
Example of acceptance measurement.

- STK hit $>$ 10.
- Polar angle $>$ 112 to take into account the Earth shadow.



Preliminary electron energy resolution

Energy resolution vs track length



Mean e. dep. fraction vs track length