HERD hermeticity study

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Simulation overview

Geometry:

STL files provided by Antonella Suma

- PSD Top frame
- PSD Top
- Calo
- PSD Side
- PSD Side frame





Objective

1) Study the hermeticity of the detector

- 2) Avoid mis-identification of particles:
- **PSD**: anti-veto to detect γ-rays.
- If a charged particle crosses the PSD frame and reaches the CALO, without passing through the active PSD region, it can be misidentified as a γ-ray.
- Build a PSD geometry to reduce as much as possible this type of events.

Simulation overview

Particles:

10M of geantinos

- Virtual GEANT4 particles
- Massless and chargeless
- They don't interact with anything
- They just cross the detector and go straight



Simulation overview

Generation surface:

Hemisphere

- Center in (0, 0, -47) cm (bottom of the detector)
- Radius 200 cm, to cover the entire geometry







Method

Trigger: particle crossing the CALO.

O2 For triggered events, we check the volumes crossed by the particle.



O3 An event is GOOD or BAD depending on the sequence of crossed volumes:

GOOD

BAD

- PSD + CALO
- FRAME + CALO
- FRAME + PSD + CALO GOOD



Geometries

• Different PSD TOP geometries were tested:

ID	Active Area	Electronics	Tot
Attuale	2000x2000x50	100x75x50	2200
Minimo 1	1630x1630x50	100x75x50	1830
Intermedio 1	1730x1730x50	100x75x50	1930
Intermedio 1.2	1740x1740x50	100x75x50	1940
Minimo 2	1830x1830x50	100x75x50	2030
Intermedio 2	1930x1930x50	100x75x50	2130



Results

• Number of particles: **10M**

Geom Tot	Trigger (%)	Bad events TOP	Bad events SIDE	Tot bad events (%)
1830	7.15	264	866	~ 0.16
1930		8	846	~ 0.12
1940		3	846	~ 0.12
2030		0	846	~ 0.12
2130		0	846	~ 0.12
2200	//	0	846	~ 0.12

For geometry 2030 and bigger no bad events from the TOP frame

Results

• For bad events, we can look at the **entry position** in each volume





Bad events from PSD SIDE FRAME enter only from the bottom





"Top inside" geometry

Perform same study on a different configuration lacksquare

Generation surface:

Hemisphere

- Center in (0, 0, -85.5) cm (bottom of the detector)
- Radius 200 cm, to cover the entire geometry
- Number of particles: 10M
- Triggered events: 7.15% \bullet
- Bad events: 1 from PSD SIDE FRAME \bullet
- Bad event rate over triggered events: 0.00014% \bullet

This configuration doesn't have the bottom part of the PSD SIDE FRAME



Conclusions

- GEANT4-based simulation for HERD hermeticity study for different geometries
- Trigger request: particle crossing the calorimeter. Can be easily changed asking for a minimum track length in the calorimeter
- Bad events are particles crossing in sequence PSD frame and CALO. Different TOP geometries were tested :
 - 1830: bad event rate over triggered events of **0.15%**
 - 1830, 1930, 1940 have some bad events from TOP FRAME
 - 2030, 2130, 2200: bad event rate over triggered events of **0.12%**
 - 2030, 2130, 2200 have bad events only from SIDE FRAME, from the bottom
- "Top inside" geometry :
 - Just 1 bad event from SIDE FRAME
 - The configuration doesn't have the bottom part of the SIDE FRAME