

# Unvetoed events in the 2014 Test Beam data

S. Lukić

Vinča institute of nuclear sciences, University of Belgrade

FCAL Session ECFA 2016  
May 31st, 2016, Santander, Spain

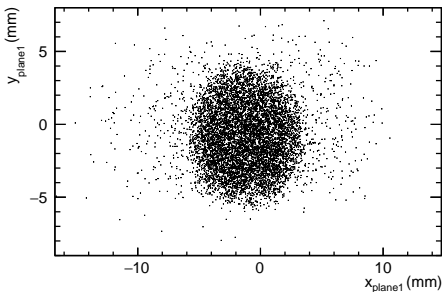


HEP & ROVA VITC\*



# Unvetoed tracks

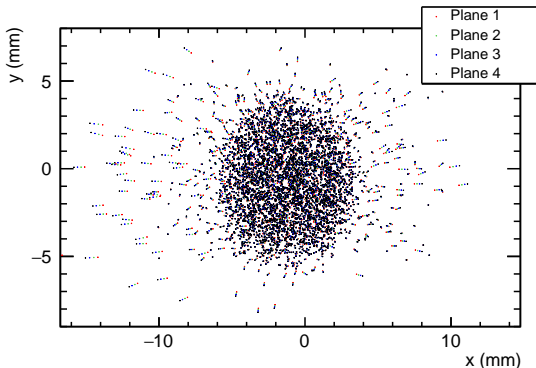
- In TB 2014 a scintillation counter with a 9mm circular hole was used to veto upstream showers and restrict data to tracks hitting telescope and the LumiCal prototype.
- Distance veto counter – first prototype plane  $d = 626$  mm
- Part of track projections to the prototype is **outside** of the projection of the hole. Why?
- Track angles and associated  $E$  deposits in the prototype analysed to try to give an answer. (Track and deposit data courtesy of Oron.)



Track projections onto the 1st prototype plane

# Angles – muons

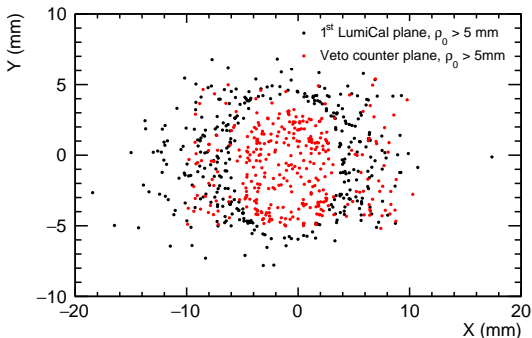
- Muon selection:
  - Narrow track in the prototype (at most 16 pads above the  $3\sigma_{bkg}$  threshold)
  - COG close to the longitudinal center of the 4 planes
- Tracks detected outside the hole mostly spread outwards!



## Muon track projections onto all four prototype planes

# Angles – muons

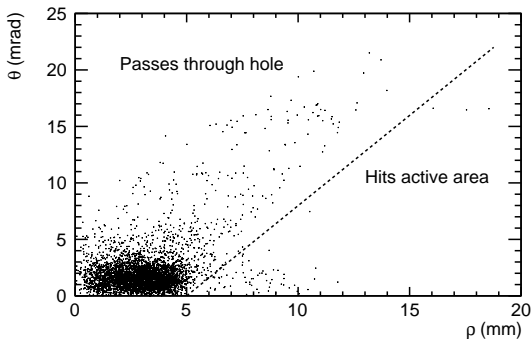
- Part of muons outside the hole image at 1st LumiCal plane clearly due to divergent tracks  
→ They actually pass through the hole at the veto counter plane!



**Muon track intersections with the 1st LumiCal plane and the veto counter plane. Only those tracks are shown that intersect the 1st LumiCal plane outside the hole image.**

# Angles – muons

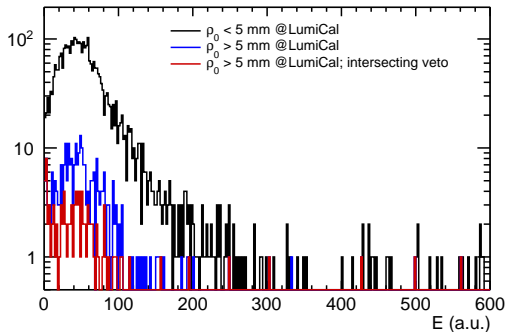
- Part of muons outside the hole clearly due to divergent tracks  
→ They actually pass through the hole!
- Small fraction of muons actually hit the veto counter



Muon angles vs. distance  $\rho$  from the hole image centre  
at the 1st prototype plane

# Energy – muons

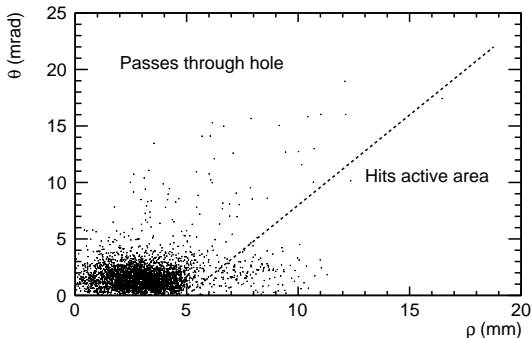
- Small fraction of “muons” actually hit the veto counter  
→ actual muons deposit energy below veto counter threshold  
→ noise tracks (randomly collinear noise in the telescope).
- Energy deposit in LumiCal has Landau ⊗ Gauss distribution except for the noise tracks



Muon energy deposit spectrum – sum over the four prototype planes

# Angles – electrons

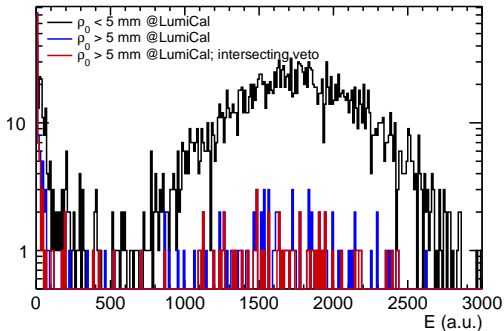
- “Electrons” = “All events not satisfying muon selection cuts”  
→ In particular, no conditions on LumiCal deposits.
- Part of “electrons” outside the hole due to divergent tracks
- Some registered “electron” tracks intersect the veto counter



**“Electron” track angles vs. distance from the hole image centre at the 1st prototype plane**

# Energy – electrons

- “Electrons” = “All events not satisfying muon selection cuts”  
→ In particular, no conditions on LumiCal deposits.
- Some registered “electron” tracks intersect the veto counter
  - Energy deposit in the prototype  $< 1$  MIP. Noise tracks.
  - Energy deposit in the prototype several 10 MIP. Double tracks?



Electron energy deposit spectrum – sum over the four prototype planes



# Conclusions

- Track angles and associated  $E$  deposits in the prototype were analysed on a small sample of FCAL TB 2014 data to find reason(s) behind unvetoed tracks.
- Several sources found for track projections outside of the image of the hole on the prototype planes:
  - ① Particles passing through the hole at an angle w.r.t. the beam – properly unvetoed
  - ② Track with (almost) no energy deposit in Lumical: Random collinear noise in the telescope
  - ③ Track intersects active volume of the veto counter,  $E$  deposit present in Lumical: More than one possible explanation
    - Energy deposit below threshold in the veto counter (inefficiency)
    - Double tracks in the telescope

Case	Fraction (electrons) (%)	Fraction (muons) (%)
Correctly not vetoed	2.1(3)	5.1(4)
Noise tracks	3.3(3)	0.6(1)
Inefficiency / double tracks	2.2(3)	2.4(3)