

Unvetoed events in the 2014 Test Beam data

S. Lukić

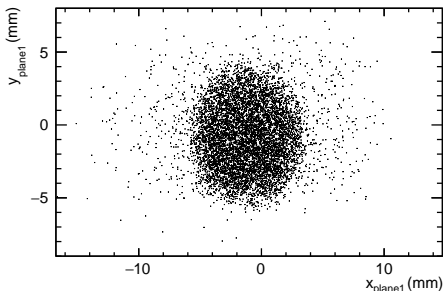
Vinča institute of nuclear sciences, University of Belgrade

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Unvetoed tracks

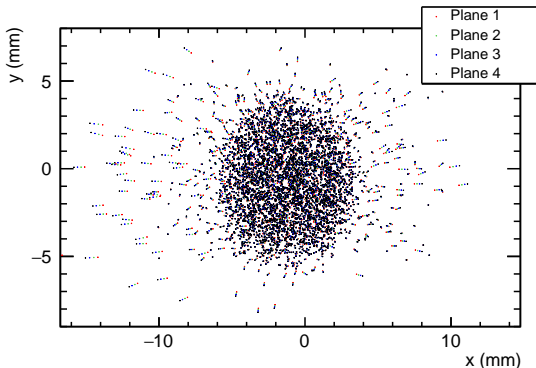
- Veto scintillator with a 9mm circular hole in TB 2014 to restrict data to tracks hitting telescope and the LumiCal prototype.
- Distance veto scintillator – first prototype plane $d = 626$ mm
- Part of track projections to the prototype is **outside** of the projection of the hole. Why?
- Track angles 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

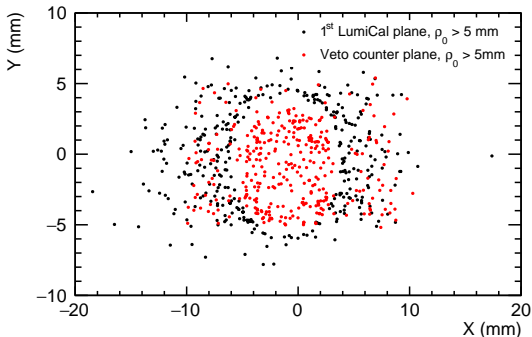
- Muon selection:
 - Narrow track in the prototype (at most 16 pads above the $3\sigma_{bkg}$ threshold)
 - COG close to the longitudinal center of the 4 planes
- Tracks detected outside the hole mostly spread outwards!



Muon track projections onto all four prototype planes

Angles – muons

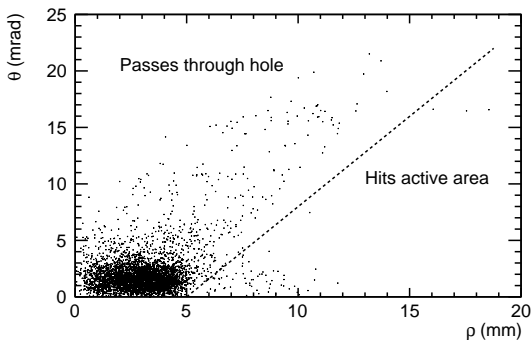
- Part of muons outside the hole image at 1st LumiCal plane clearly due to divergent tracks
→ They actually pass through the hole at the veto counter plane!



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

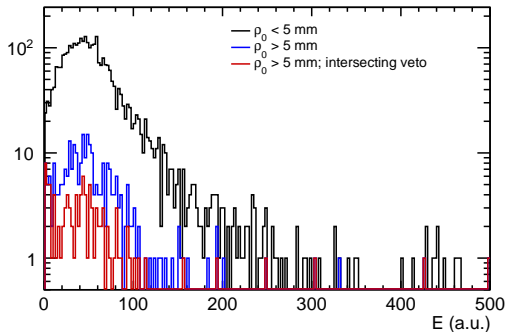
- Part of muons outside the hole clearly due to divergent tracks
→ They actually pass through the hole!
- Small fraction of muons actually hit the veto scintillator



Muon angles vs. distance ρ from the hole image centre
at the 1st prototype plane

Energy – muons

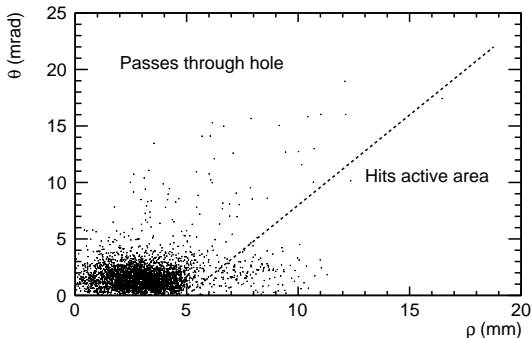
- Small fraction of “muons” actually hit the veto scintillator
 → actual muons deposit energy below veto counter threshold
 → noise tracks (randomly collinear noise in the telescope).
- Energy deposit in LumiCal has Landau \otimes Gauss distribution except for the noise tracks



Muon energy deposit spectrum – sum over the four prototype planes

Angles – electrons

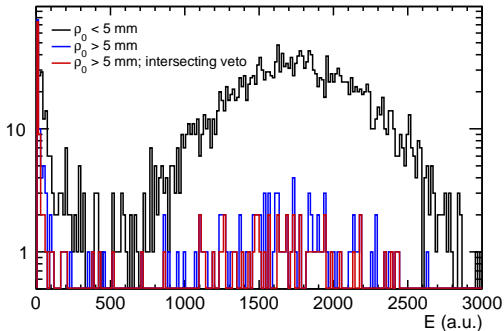
- “Electrons” = “All events not satisfying muon selection cuts”
→ In particular, no conditions on LumiCal deposits.
- Part of “electrons” outside the hole due to divergent tracks
- Some registered “electron” tracks intersect the veto scintillator



“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 scintillator
 - 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.
- Both for muon and “electron” events, unvetoed tracks include tracks that pass the hole at an angle and tracks parallel to the beam that intersect the active volume of the veto scintillator.
- Analysis of energy deposits in the LumiCal helps to understand the parallel tracks
- Overall several distinct sources exist 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,
 - ② Muons hitting the veto scintillator but leaving energy deposit below the threshold,
 - ③ Random collinear noise in the telescope.
 - ④ Double tracks (?)