Study of Beamstrahlung in the Vertex Detector

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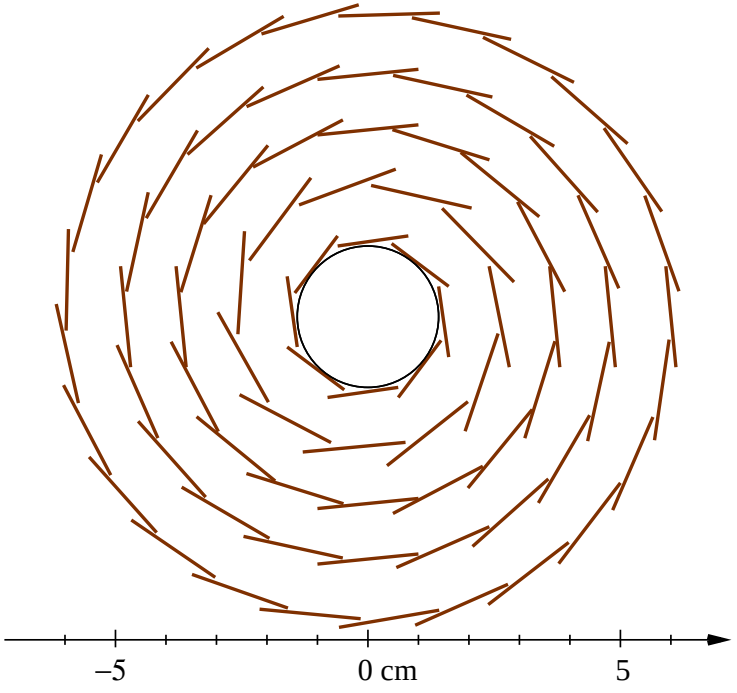
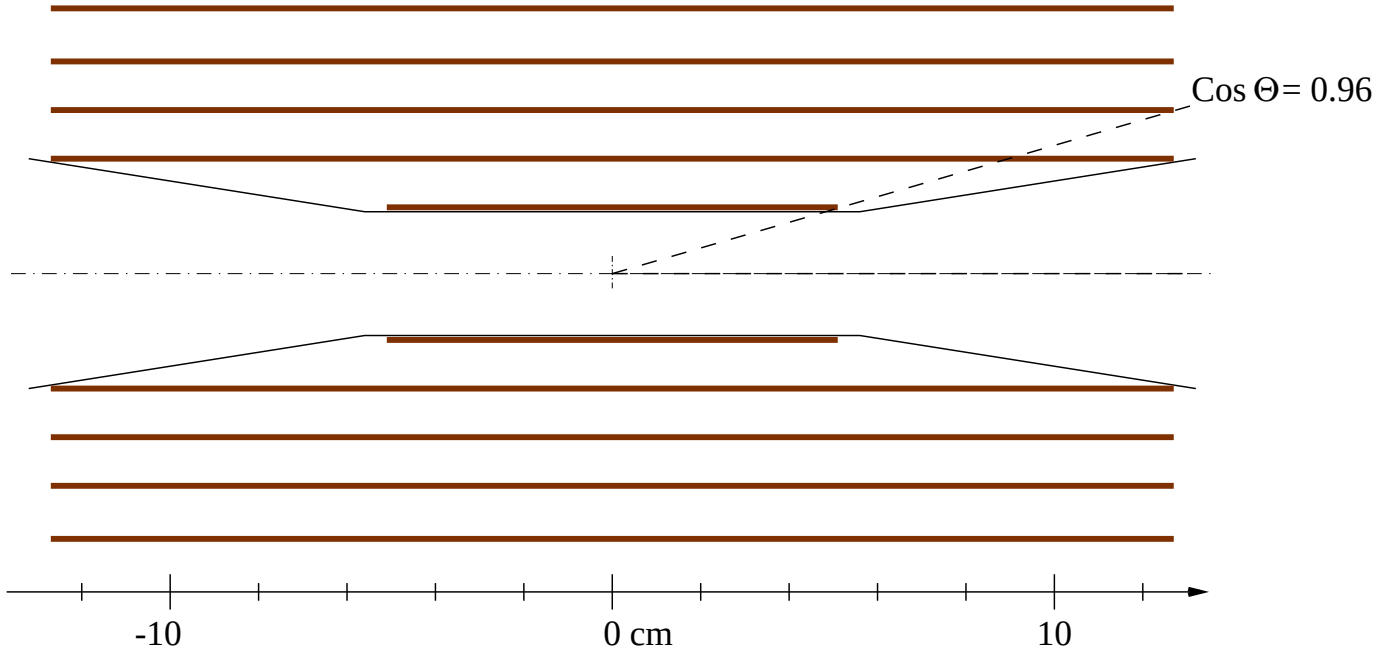
Vertex Detector layout





Layer	Radius	No. of ladders	Ladder width
1	8 - 15 mm	8	19 mm
2	26 mm	11	22 mm
3	37 mm	16	22 mm
4	48 mm	20	22 mm
5	60 mm	25	22 mm

B = 4T

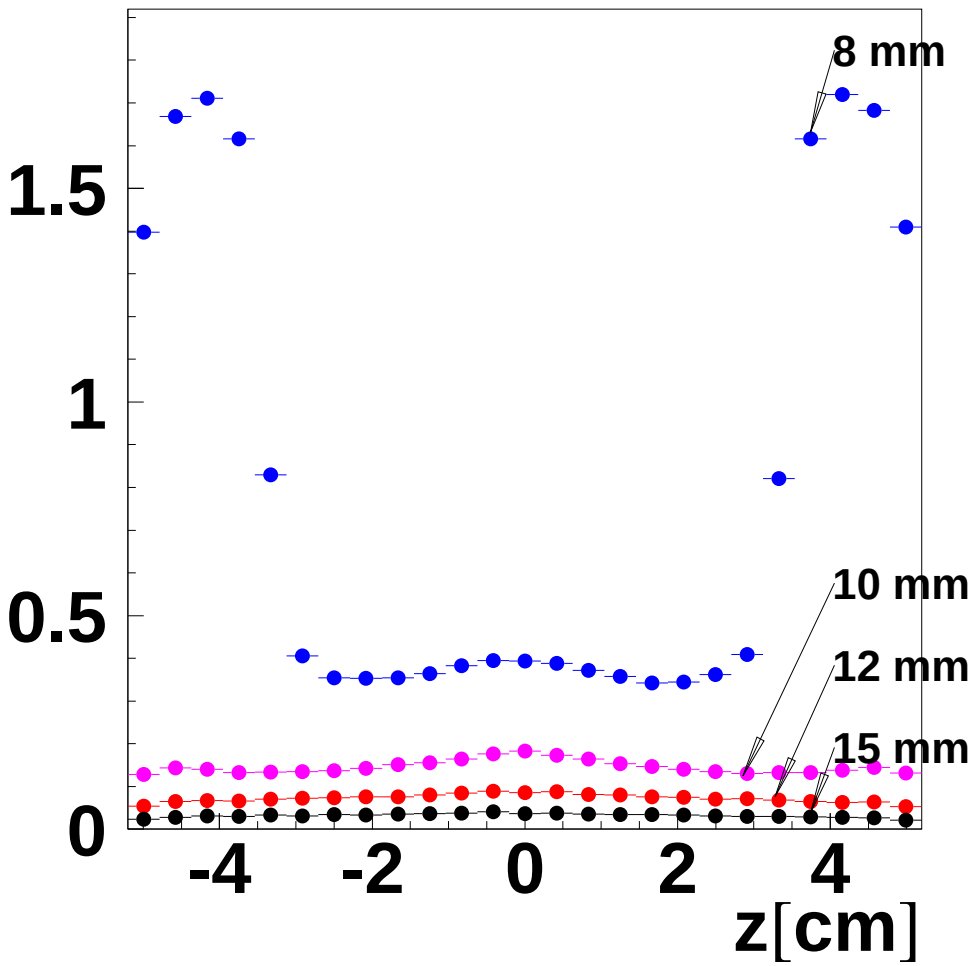
Layer thickness $50\mu m$

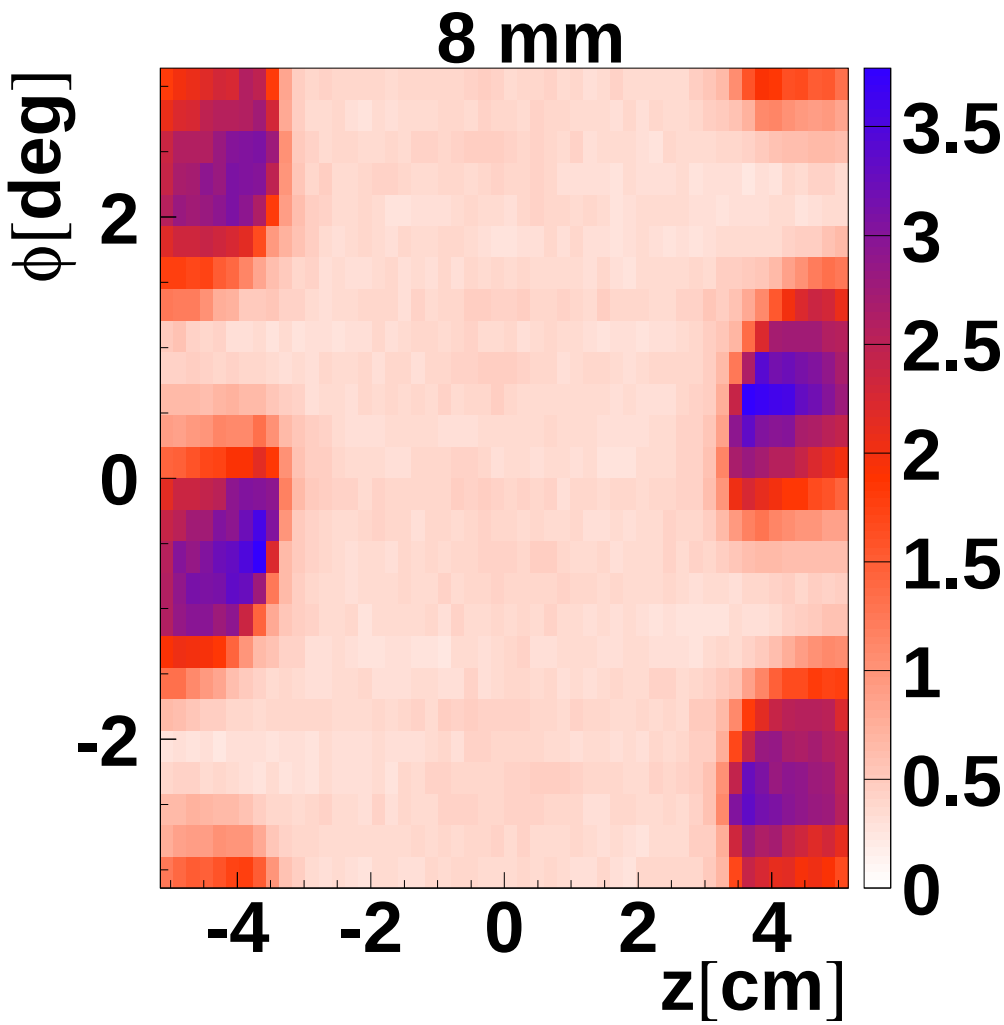
Spatial resolution $5\mu m$

Simulation of beamstrahlung

- e^+e^- pairs from beamstrahlung (background) simulated using Guinea Pig for nominal accelerator parameters @ 500 GeV.
- 14 mrad crossing angle.
- ILC detector simulation:
  - All charged particles tracked through Vertex Detector (VTX), accounting for multiple scattering and energy loss (own software tools)
  - Other detector components simulated using SGV 2.30 (fast simulation tool)
- VTX readout: 20 times per bunch train (1 readout cycle = 131 BX)
- Tracks detected in the central tracker refitted with hits from VTX (both physics and background hits) selected with Kalman Filter (own software tools)

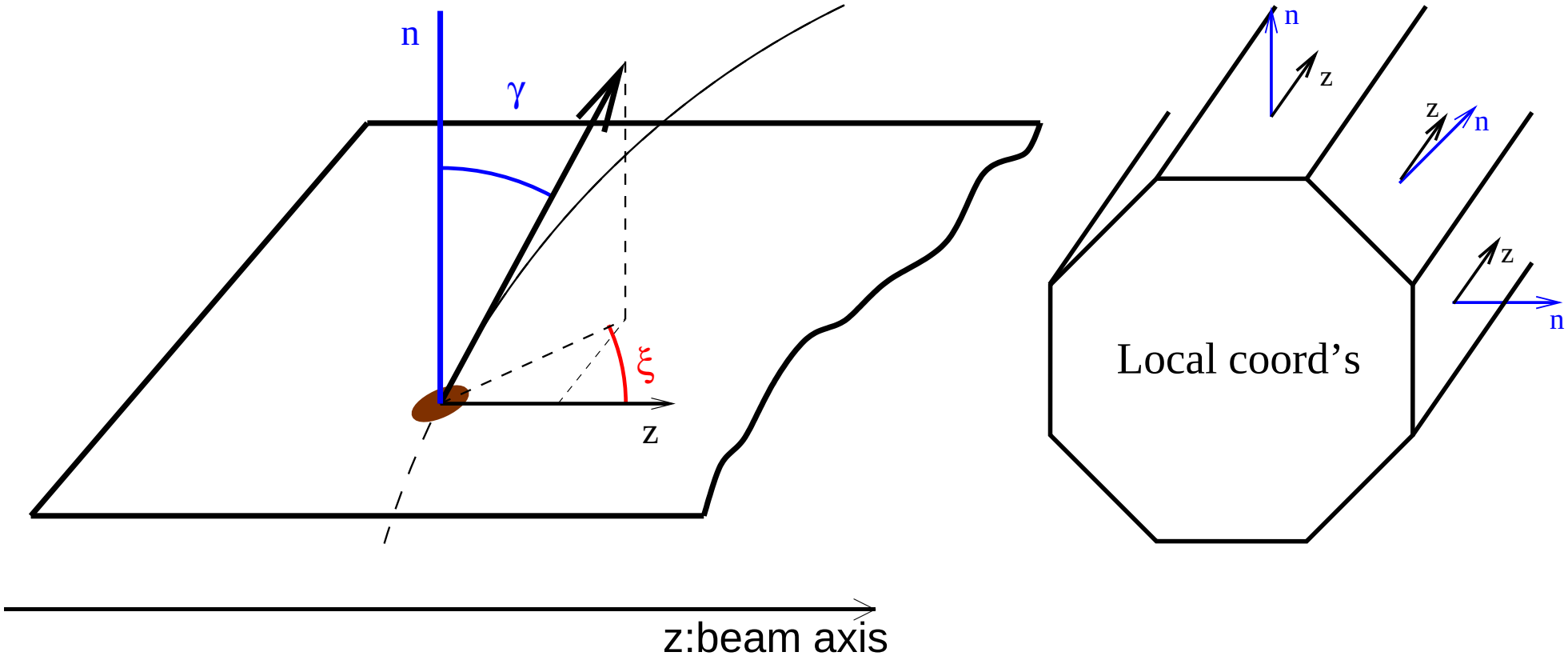
Hits/mm^2/BX, 1st layer



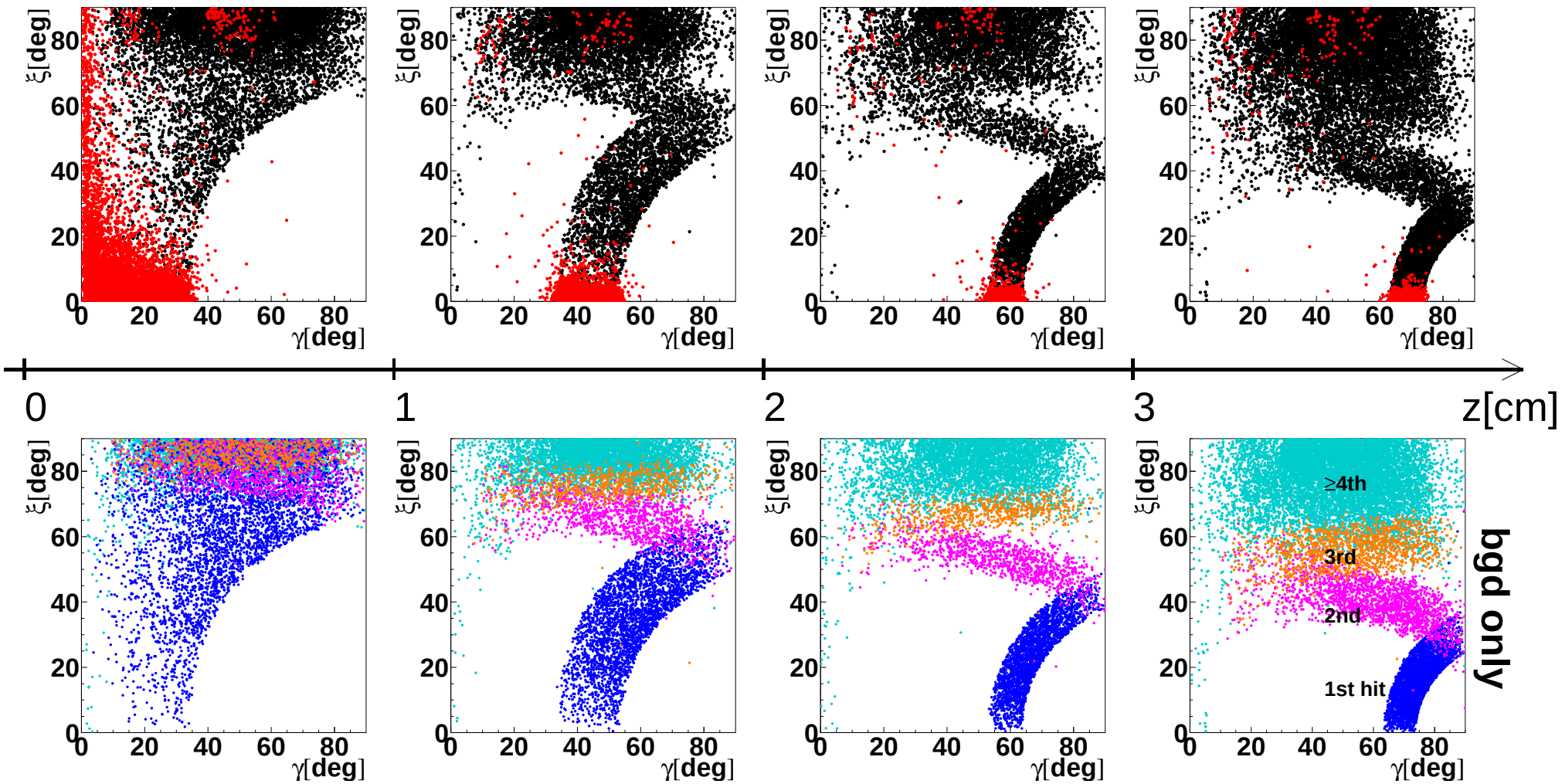


Variables describing hit cluster shape

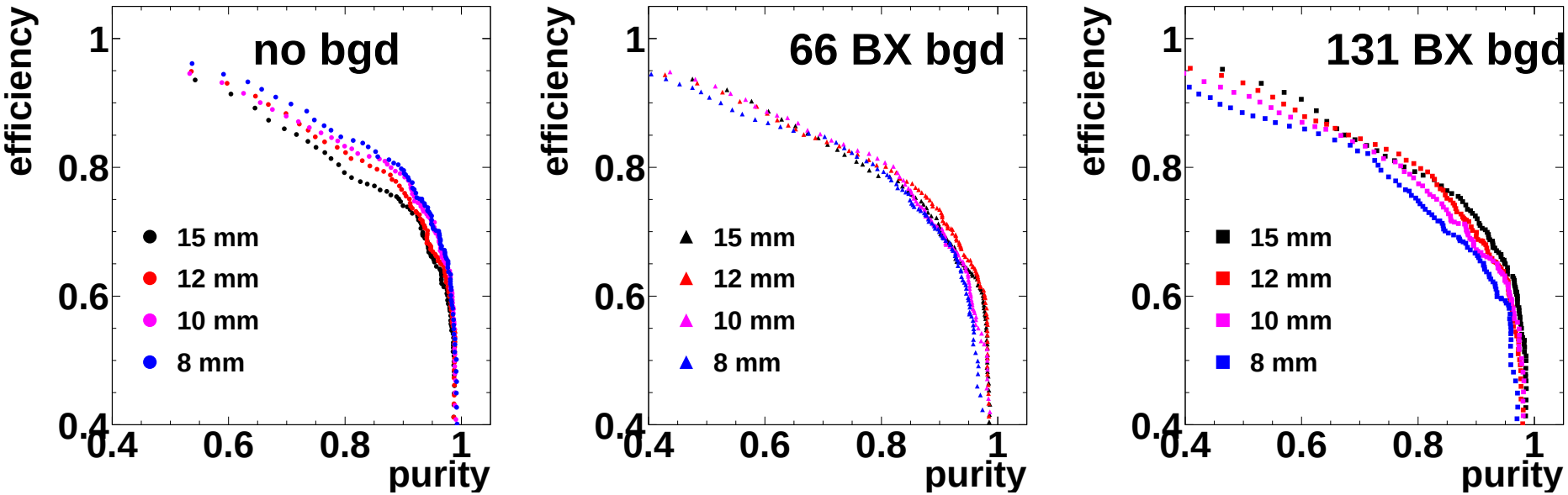
Whether hit cluster is circular or elliptical depends on incident angle γ but also on detector technology.



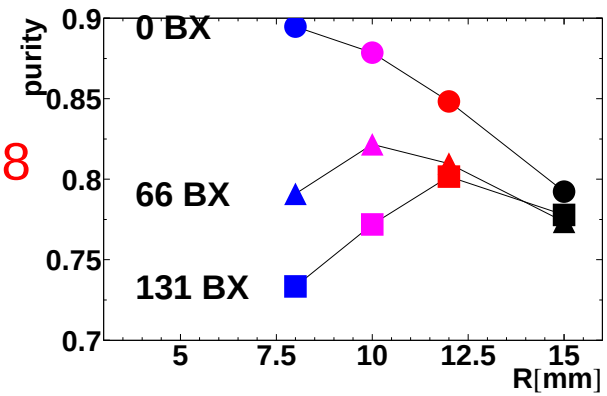
ξ vs γ : physics and background , 1st layer

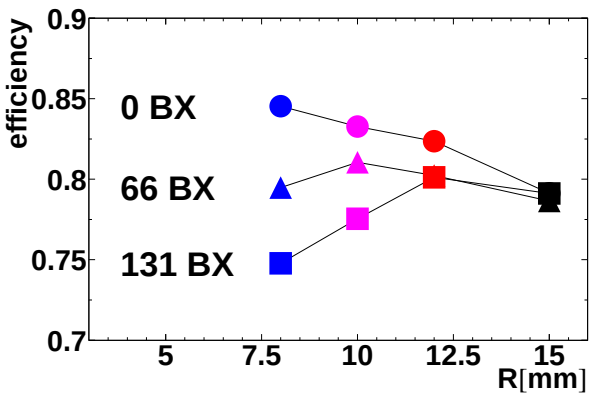


Jet flavour tagging: b



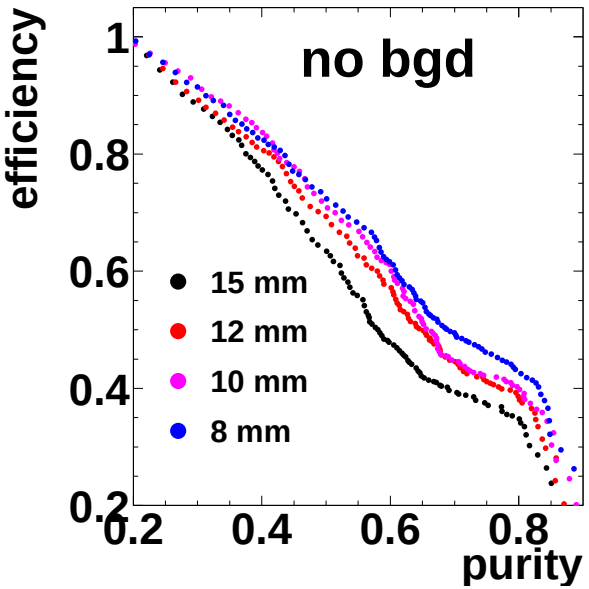
Efficiency 0.8

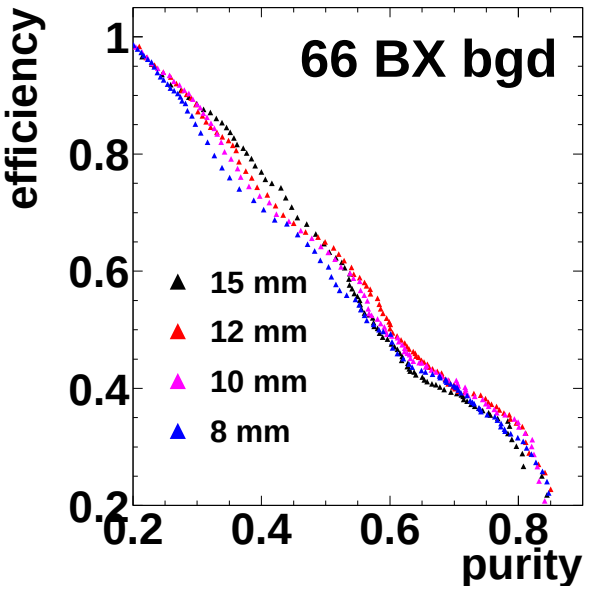


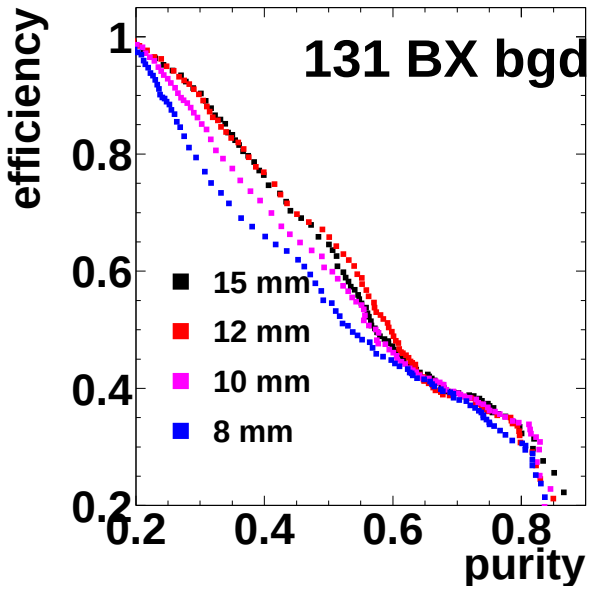


Purity 0.8

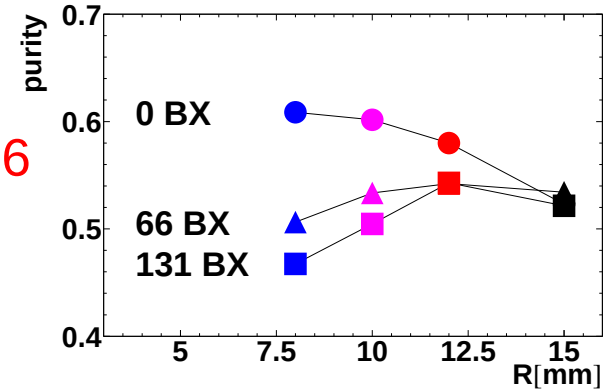
Jet flavour tagging: c

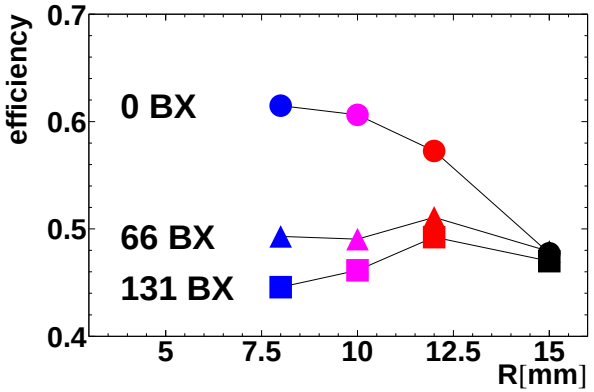






Efficiency 0.6



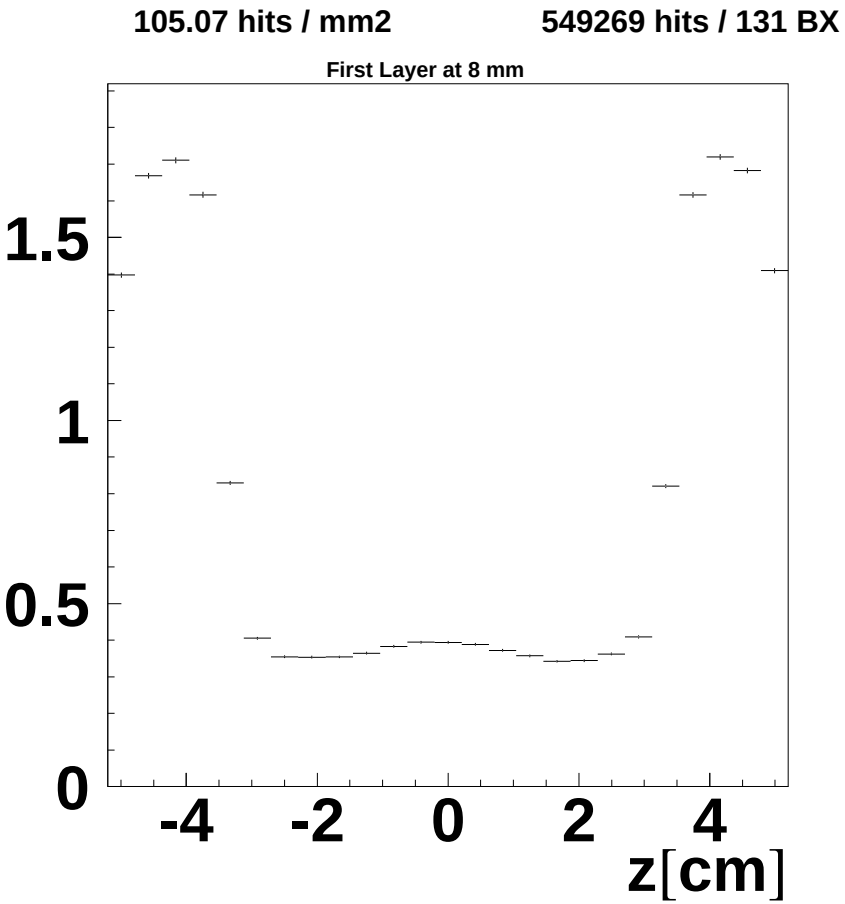


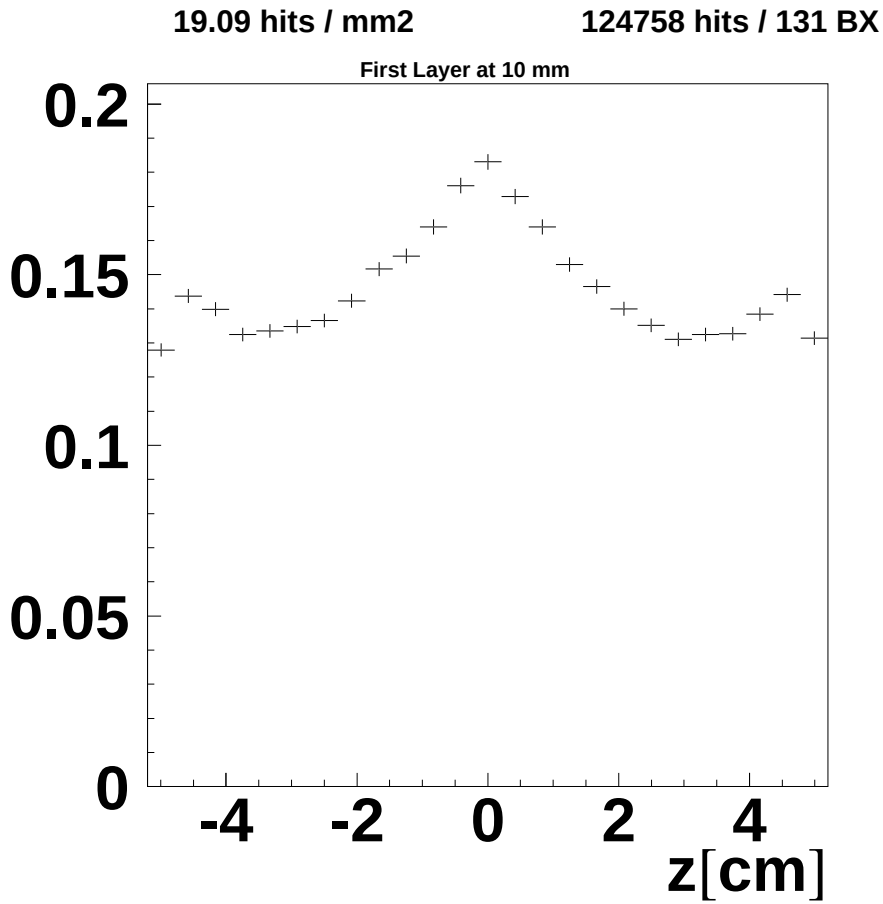
Purity 0.6

Conclusions

- One may be able to distinguish between “physics” and “background” hits provided that it will be possible to measure elongation and direction of a hit (ξ and γ) (see also talk by Lukasz Maczewski).
- Jet tagging performance improves with reduced radius of first layer but only with no e^+e^- background. The background reduces jet tagging performance more strongly for smaller inner layer radius.
- It is possible to find optimal inner layer radius for jet tagging (in this case 12 mm)
- Optimisation should be made for a full physics analysis (eg. $h \rightarrow c\bar{c},\ b\bar{b}$)

Additional slides: Hits/mm^2/BX





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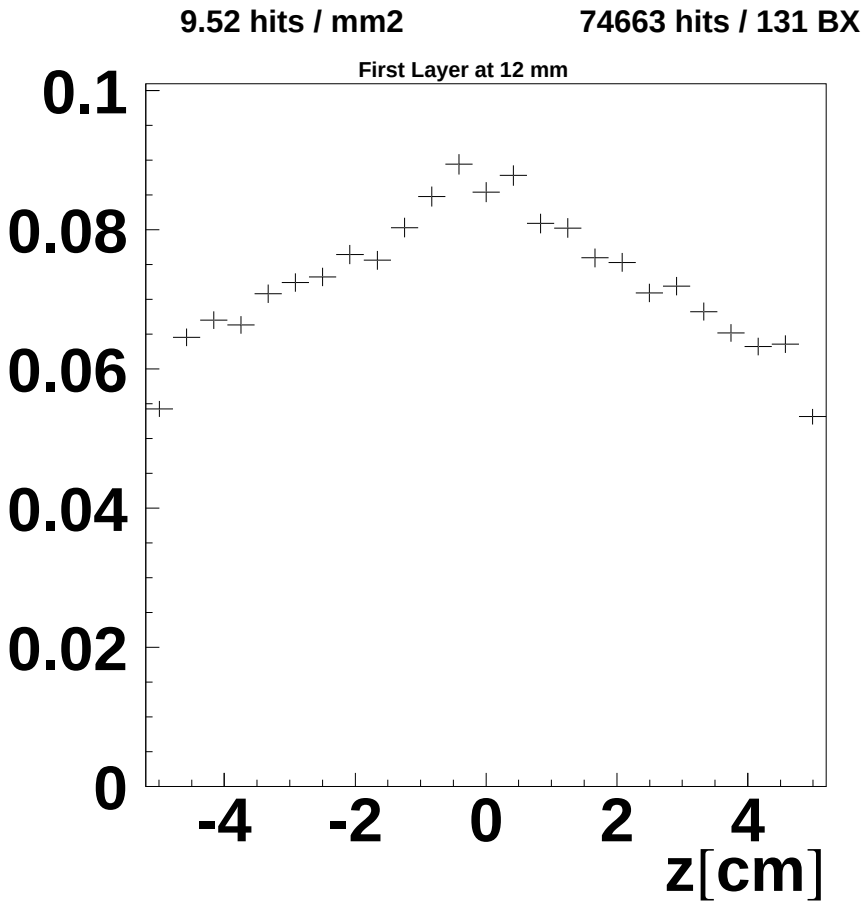

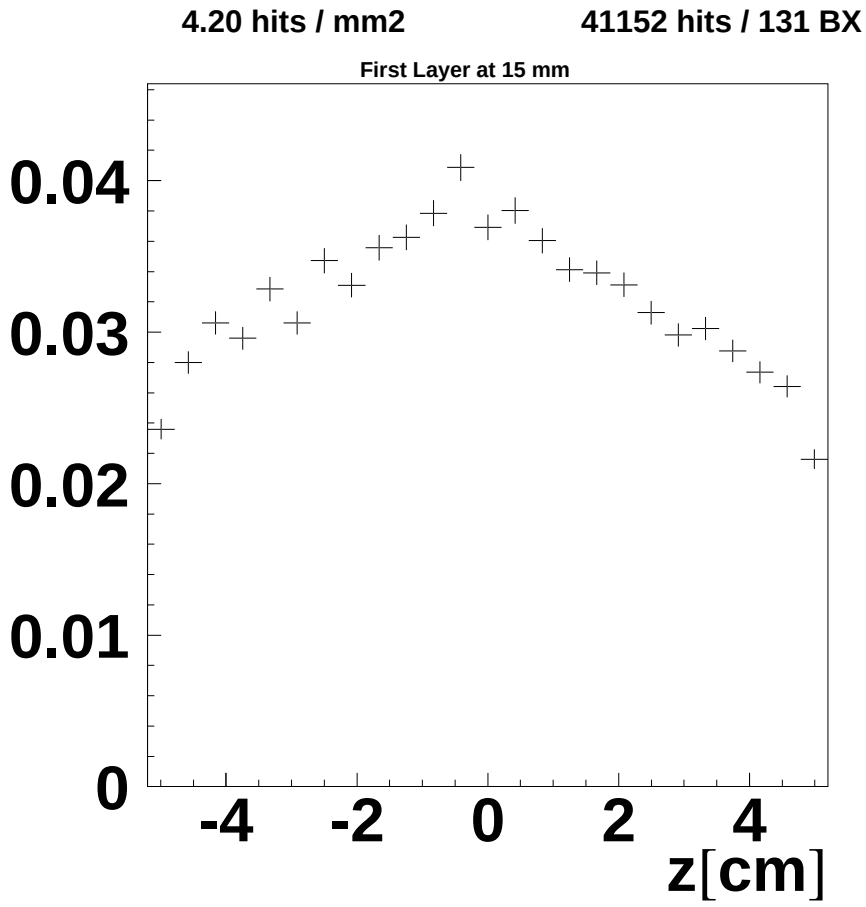

Additional slides: