Tracking and reconstruction

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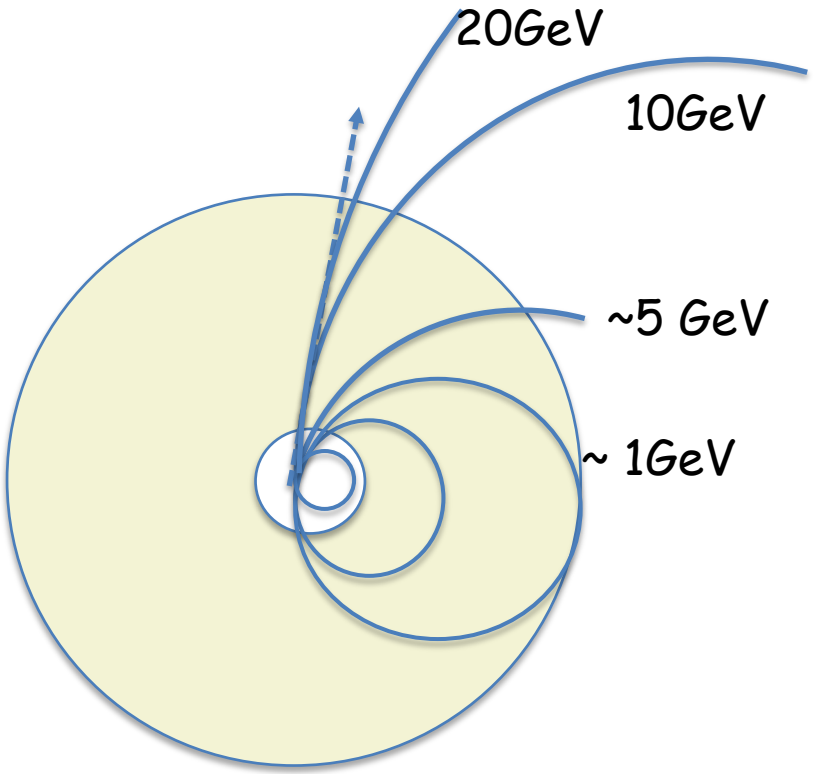
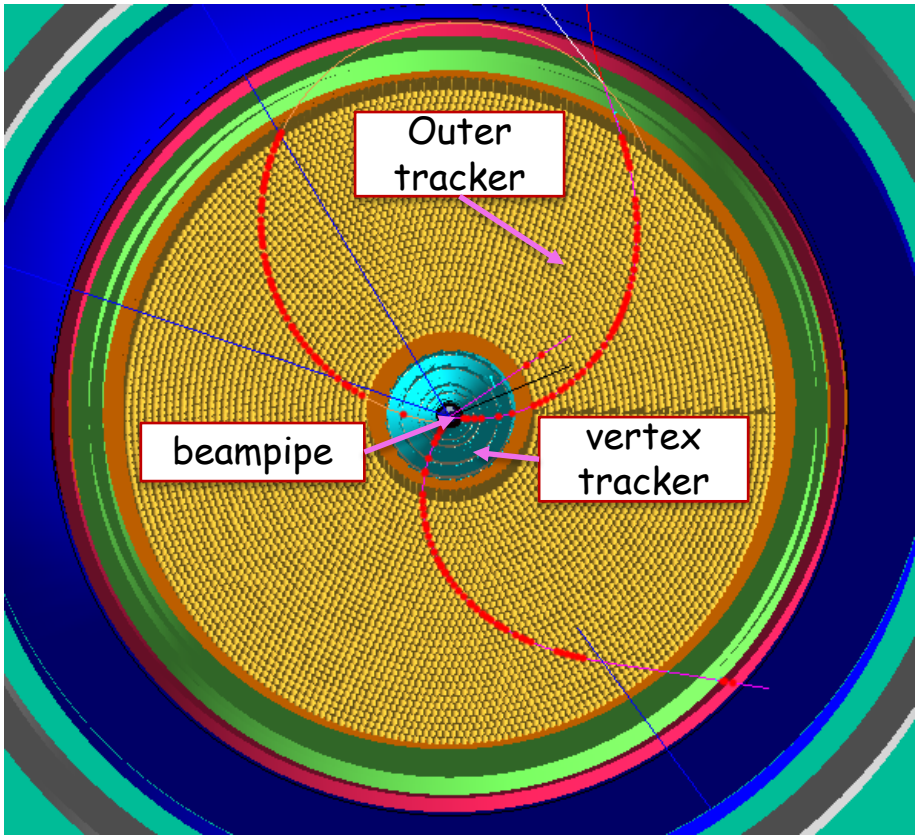
Momentum reconstruction



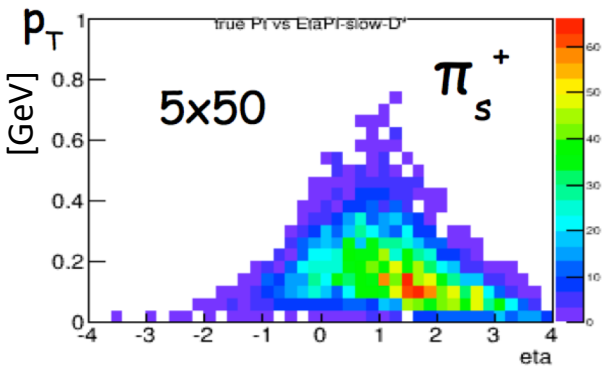


- Need high magnetic field to reconstruct bending radius: for high momentum particles, otherwise straight segment (no momentum measurements, no charge) – depends on resolution of tracker.
- Too high magnetic field: low momentum particles would curl along beampipe, without detection

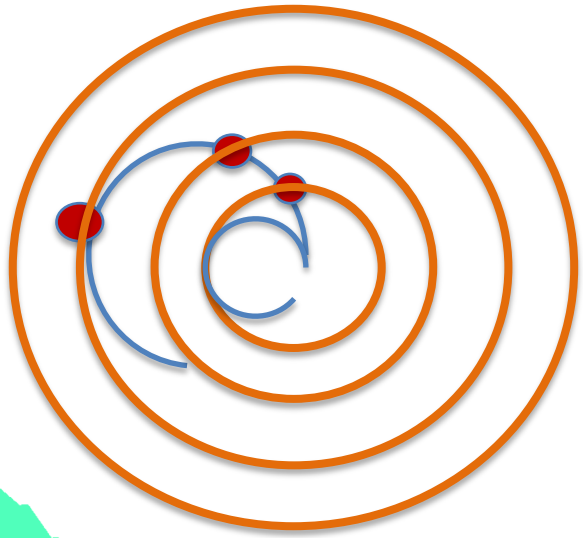
Low momentum particles

Problem of too high magnetic field:

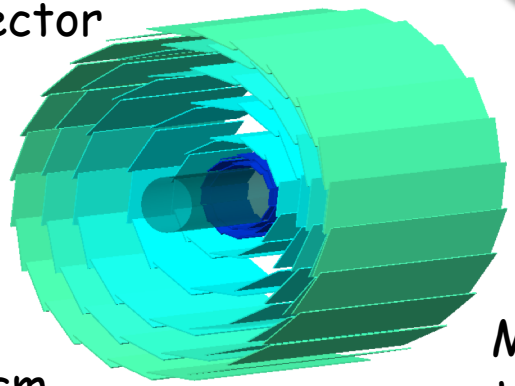
$$D^{*+} \rightarrow D^0 \pi_s^+ \rightarrow (K^- \pi^+)\pi_s^+$$



- Layered structure of vertex detectors
- For track reconstruction slow particles have to pass at least 3 layers of tracking detector



Barrel part of vertex detector



p_T [GeV] = 0.3· B [T] · R [m]

Beampipe: 3.2cm
Inner layer of outer tracker: 20 cm

Minimum pT possible to detect for 3T (at 6cm): ~ 30MeV

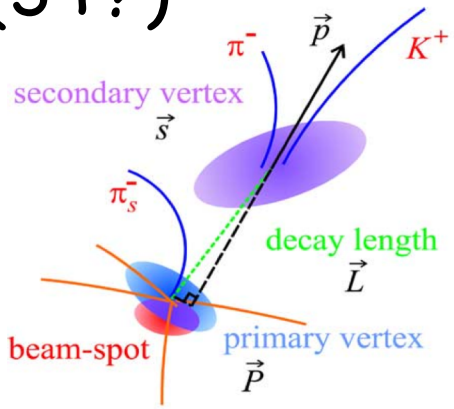
Magnetic field (3T?)

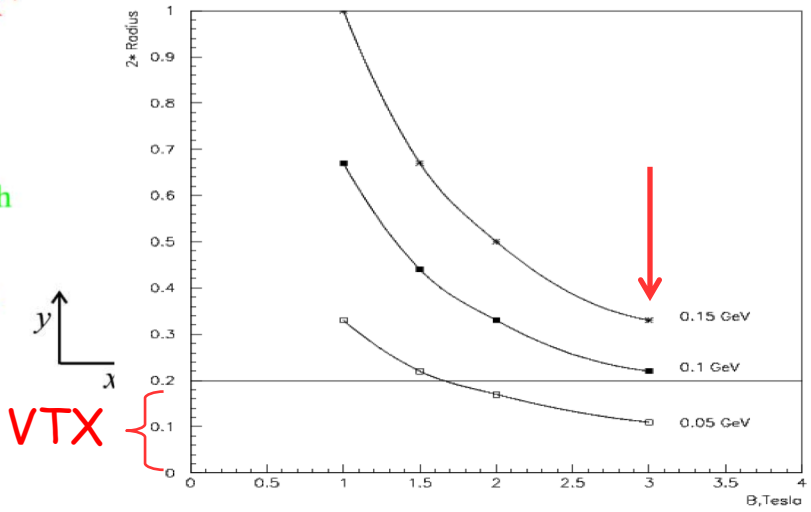
$$D^{*+} \rightarrow D^o \pi_s^+ \ , \ D^o \rightarrow K^- \pi^+$$

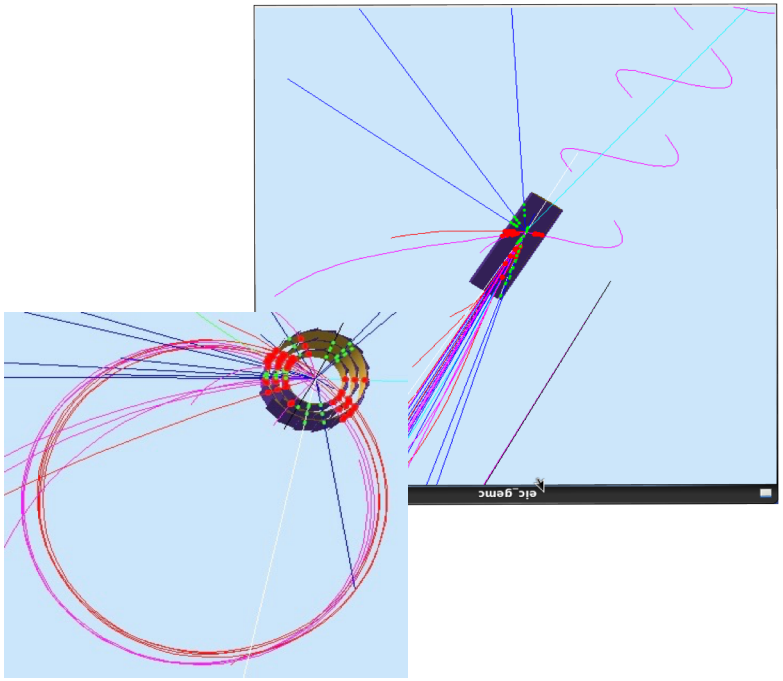
$$R(m) = \frac{P_T(GeV)}{0.3 \cdot B(T)}$$

2R > R_{out} (VTX)

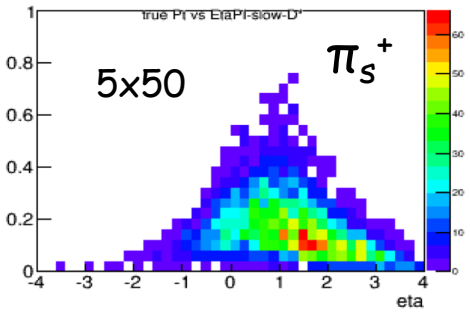
For Vertex- 20 cm in R - reserved

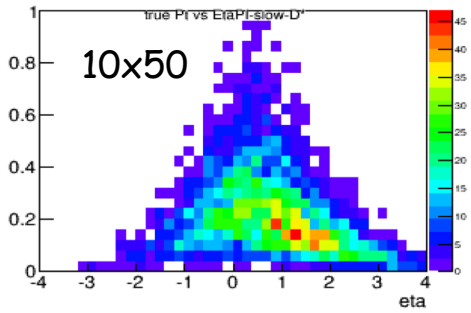


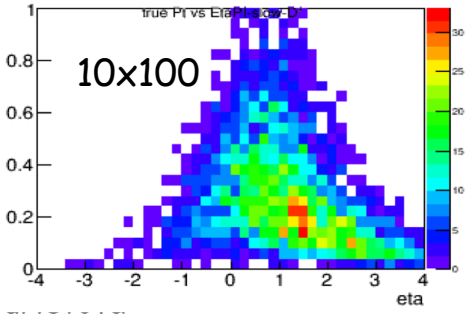


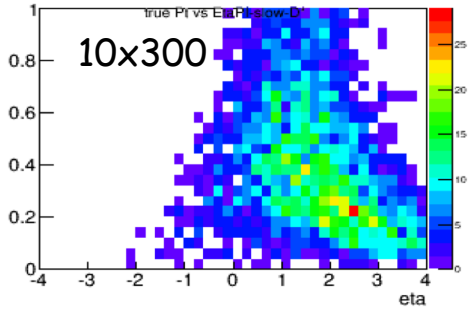


p e



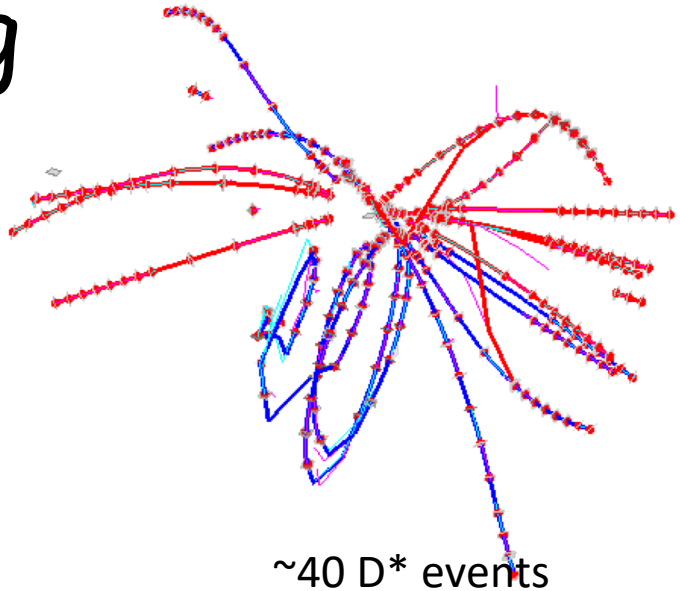


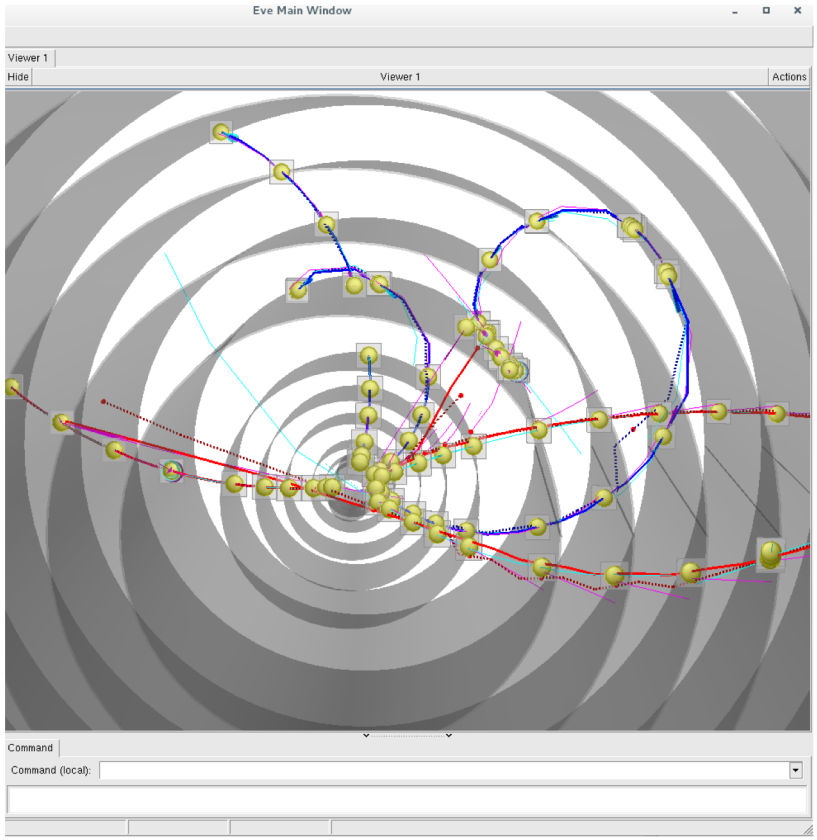




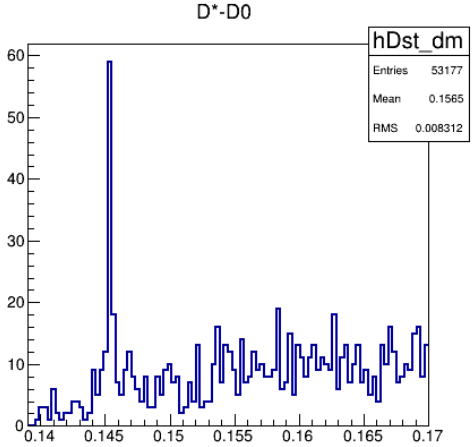
Track fitting/vertexing

Too curly tracks might create problem for tracking detectors and/or for track reconstruction

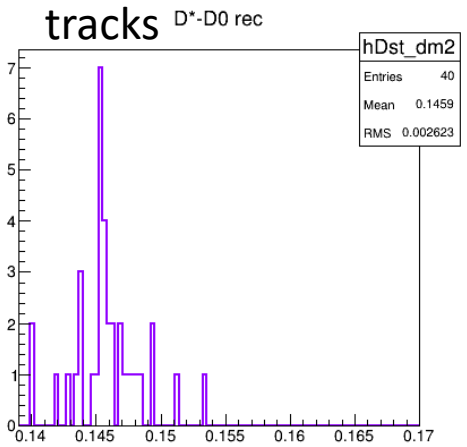




~60 D* events with TRUE MC



~40 D* events with rec. tracks



Main inefficiency is coming from reconstruction of π_slow with momentum <0.1 GeV

Examples

Position resolution only:

$$\frac{\sigma(p_T)}{p_T} = \frac{\sigma(x) \cdot p_T}{0.3BL^2}\sqrt{\frac{720}{N+4}}$$

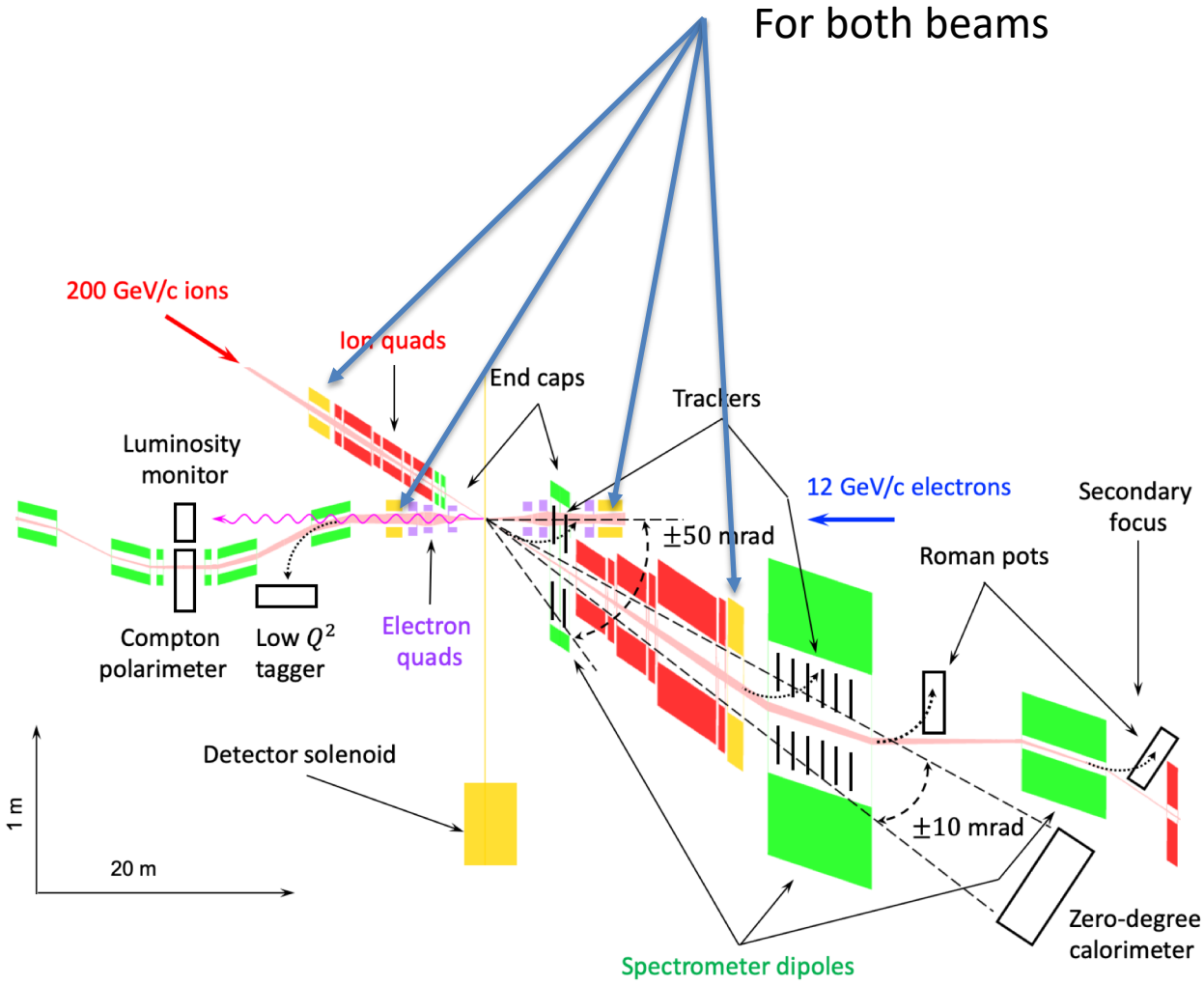
CMS $\Delta pt/pt = 1.5 \cdot 10^{-4}\, pt + 0.005$
(pt ~ 50-500GeV, 4T, L~1.1m σx~50μm for 100GeV 1.5%,η=0)

ATLAS: $\Delta pt/pt = 5 \cdot 10^{-4} pt + 0.01$
(pt ~ 50-500GeV, 2T, L~1m σx~200μm, for 100GeV 3.8%, η=0)

EIC:
(pt ~ 1-20 GeV , 3T σx~100μm for pt ~ 100GeV ~ 3% , for pT~ 10GeV ~0.3%)

ZEUS: $\Delta pt/pt = 58 \cdot 10^{-4} pt + 0.0065$ (pt ~ 1-200 GeV 1.8T)

Compensating solenoids (JLEIC)



Conclusion

- For barrel, expected PT ~ 0-10(20) GeV. With too high magnetic field tracks start to curl..
- Too high field creates inefficiency for low-Pt tracks.
- A magnitude of the field should depends on a granularity of a central detector (for all-si tracker magnetic field could be higher)
- Problem for accelerator: magnetic field should be compensated.