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Implications of particle mass
for tracker timing cuts

we're not tracking photons

N. Bartosik

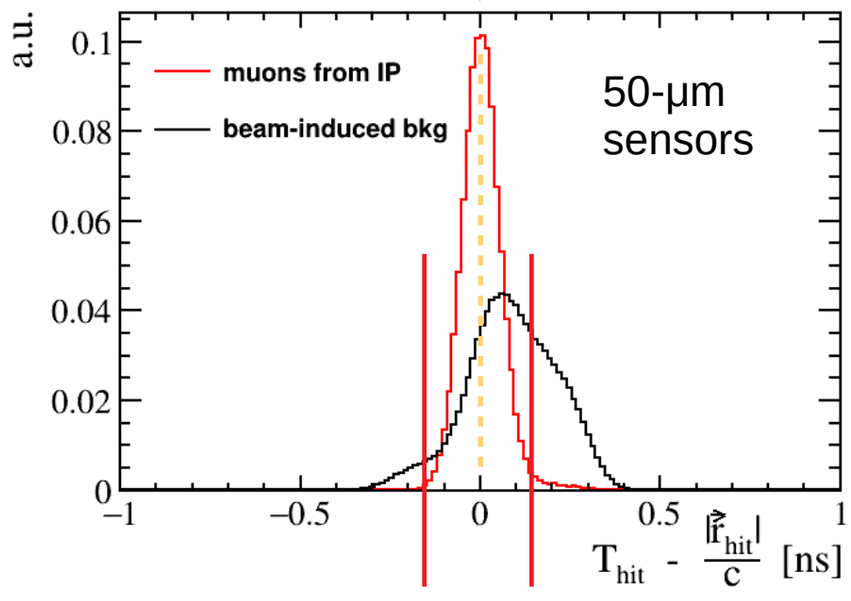
INFN Torino

Timing cuts: not so simple

We select hits in a narrow time window around T0 based on the hit position

T0 is TOF of a photon originating from (0,0,0)

↳ reasonable choice for relativistic particles



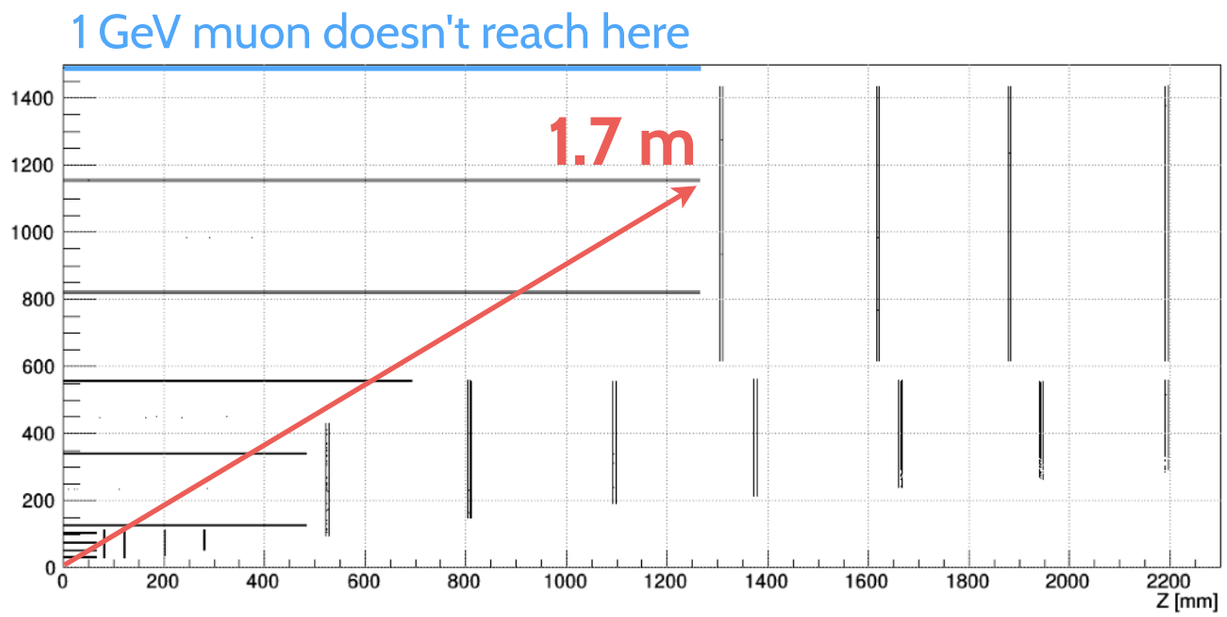
Currently we study tracking performance using muon tracks at

p	1	10	100	GeV
electron β	1	1	1	%
muon β	99.45	1	1	%
pion β	99.04	1	1	%
K± β	89.67	99.87	1	%

0.55% → 31ps at R=1.7 m a substantial delay compared to the time resolution we are considering: σ_t = 60ps

Real tracks are curved → longer path

↳ real delays are even bigger

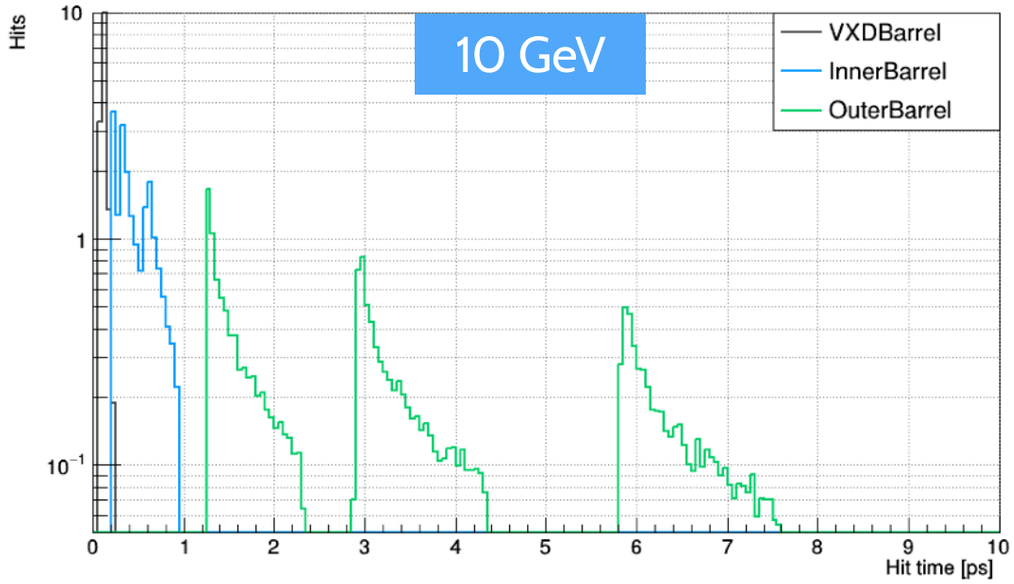


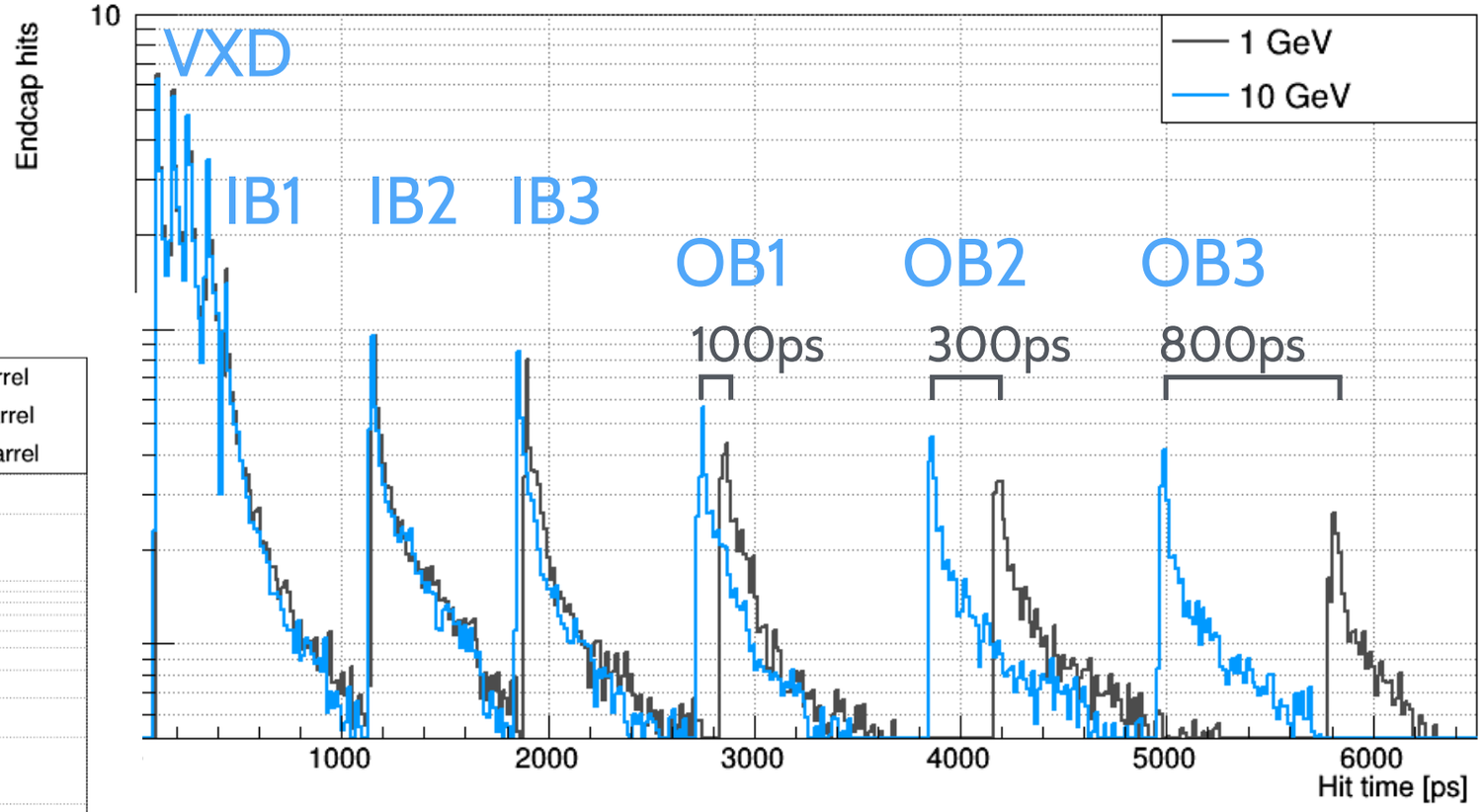
Time of flight: barrel region

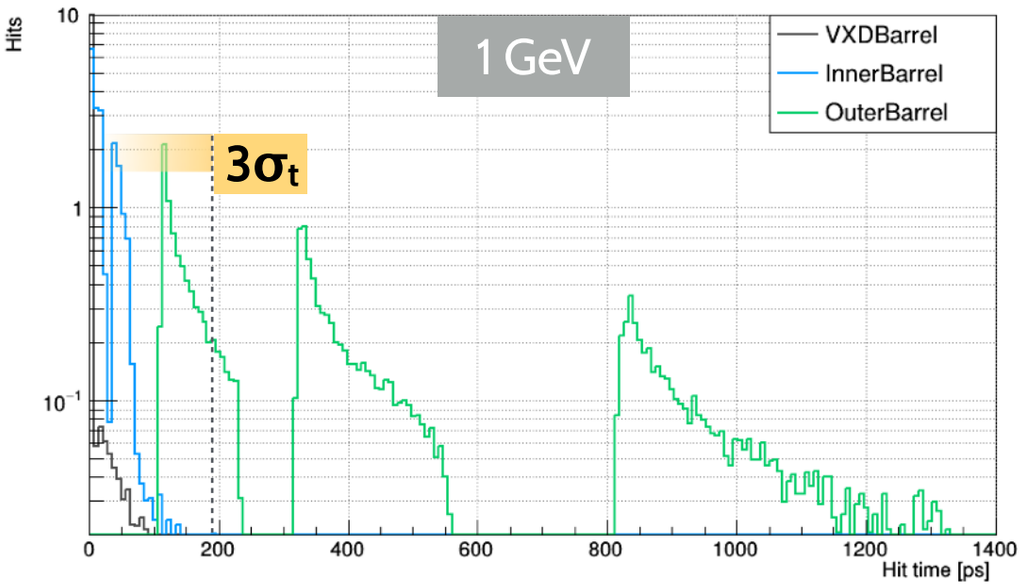
Raw SimHit time: σ_t=0 →

↳ delay in OB ~100-1000ps

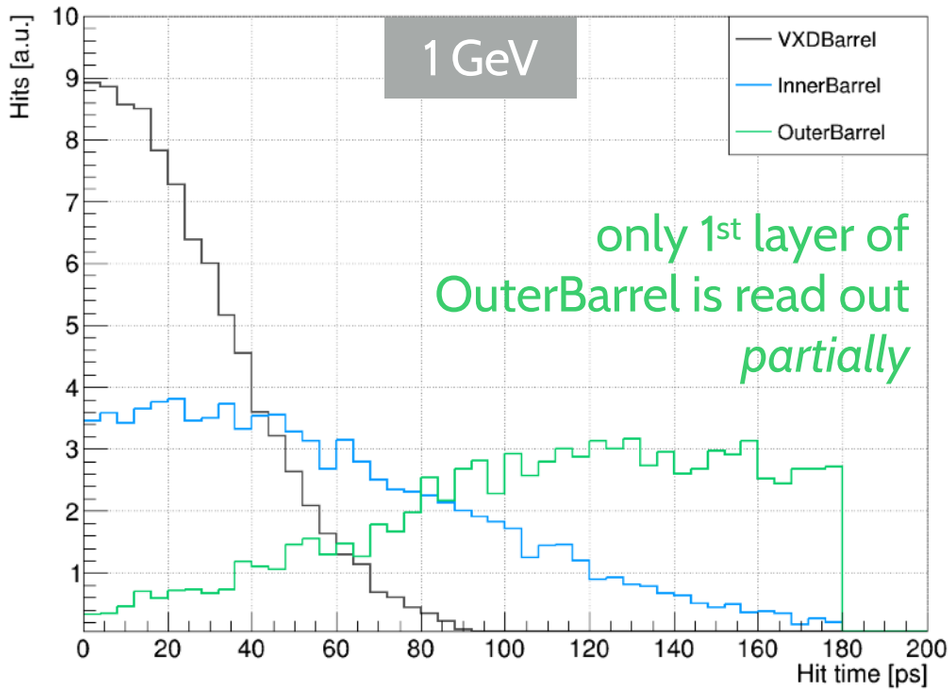
Raw SimHit time - T0 →







smeared by σ_t

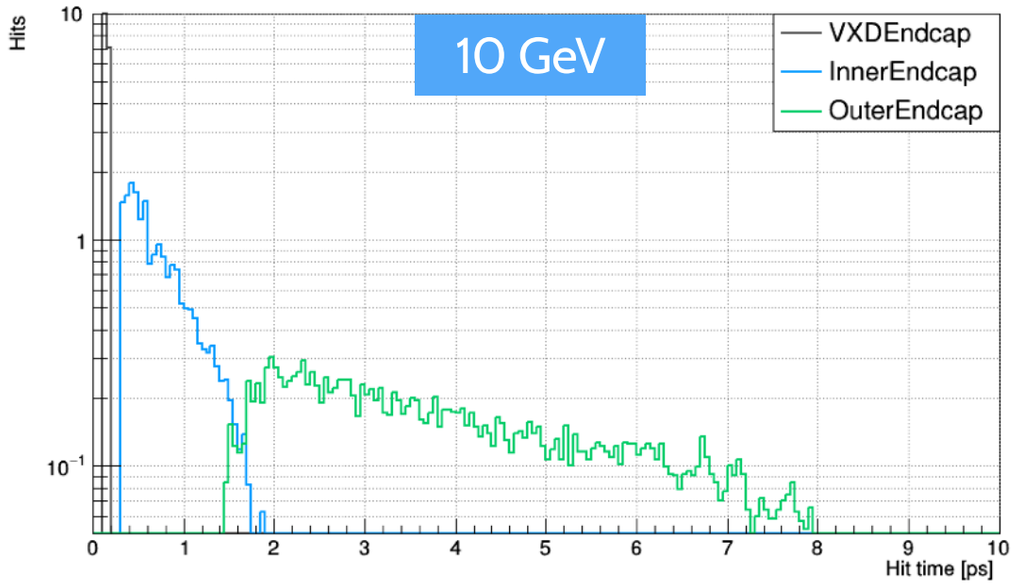


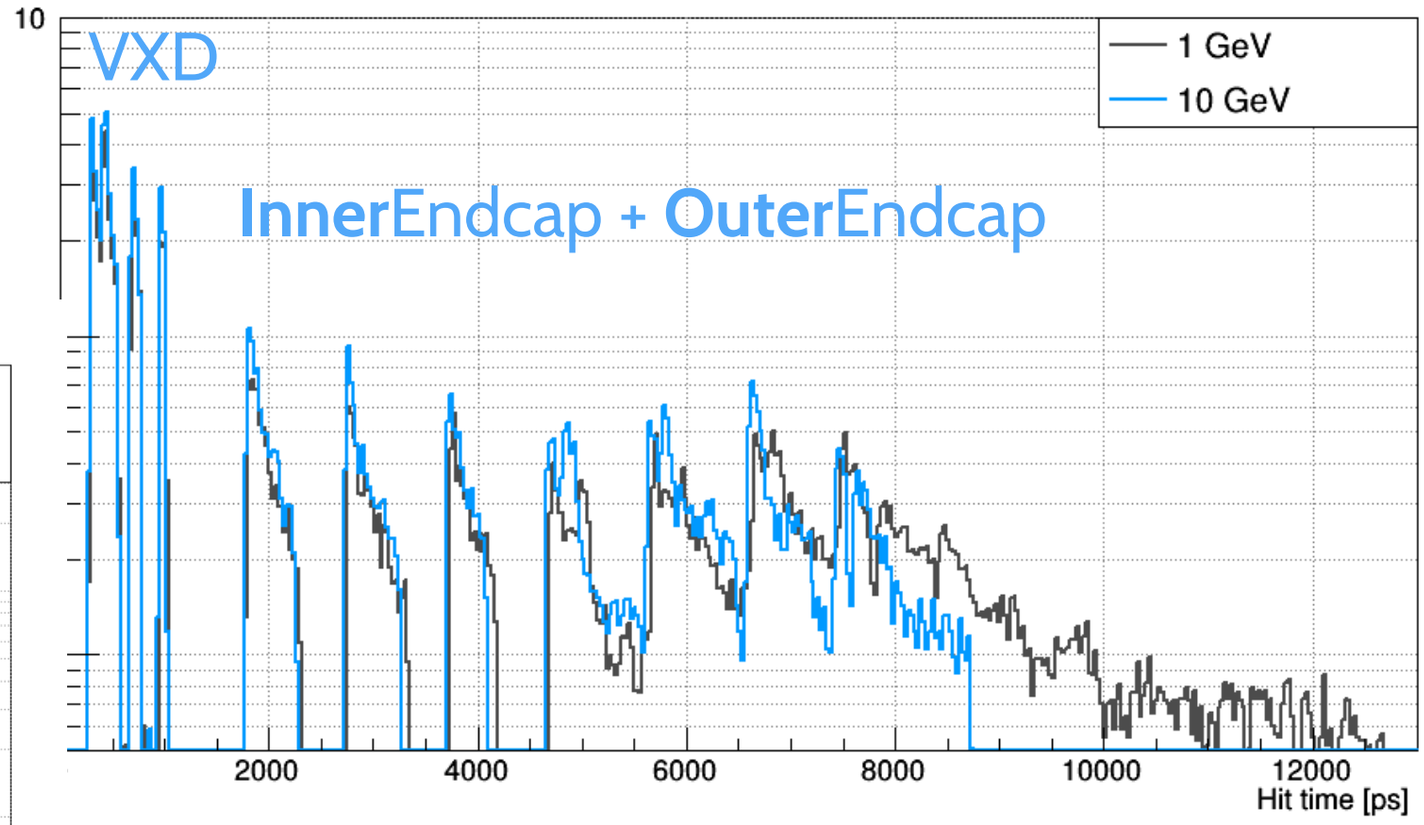
Time of flight: endcap region

Raw SimHit time: σ_t=0

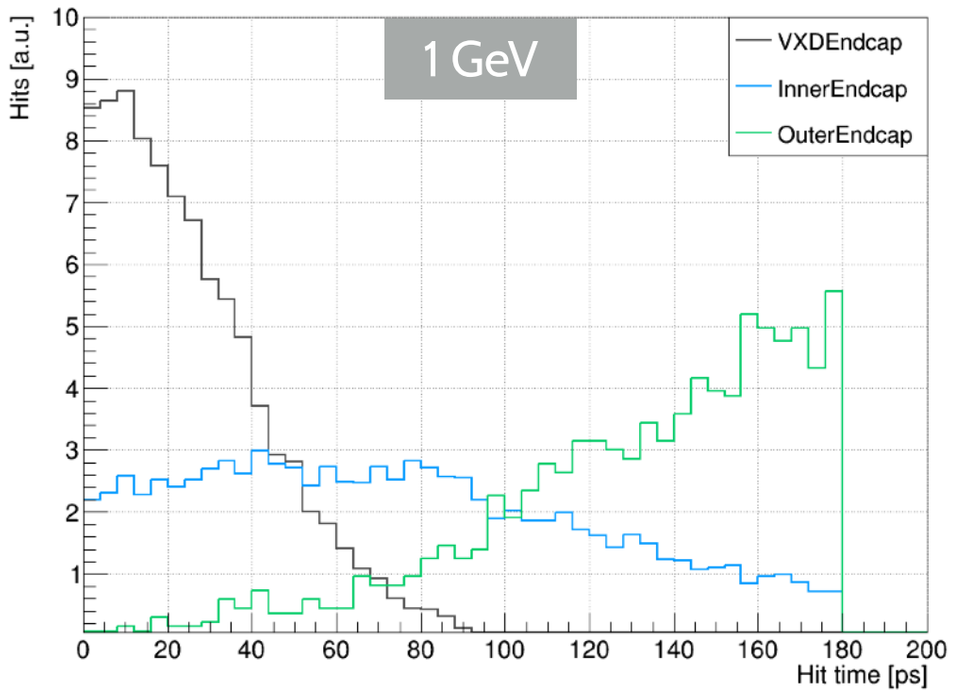
↳ delay in OB ~100-2000ps

Raw SimHit time - T0





smeared by σ_t

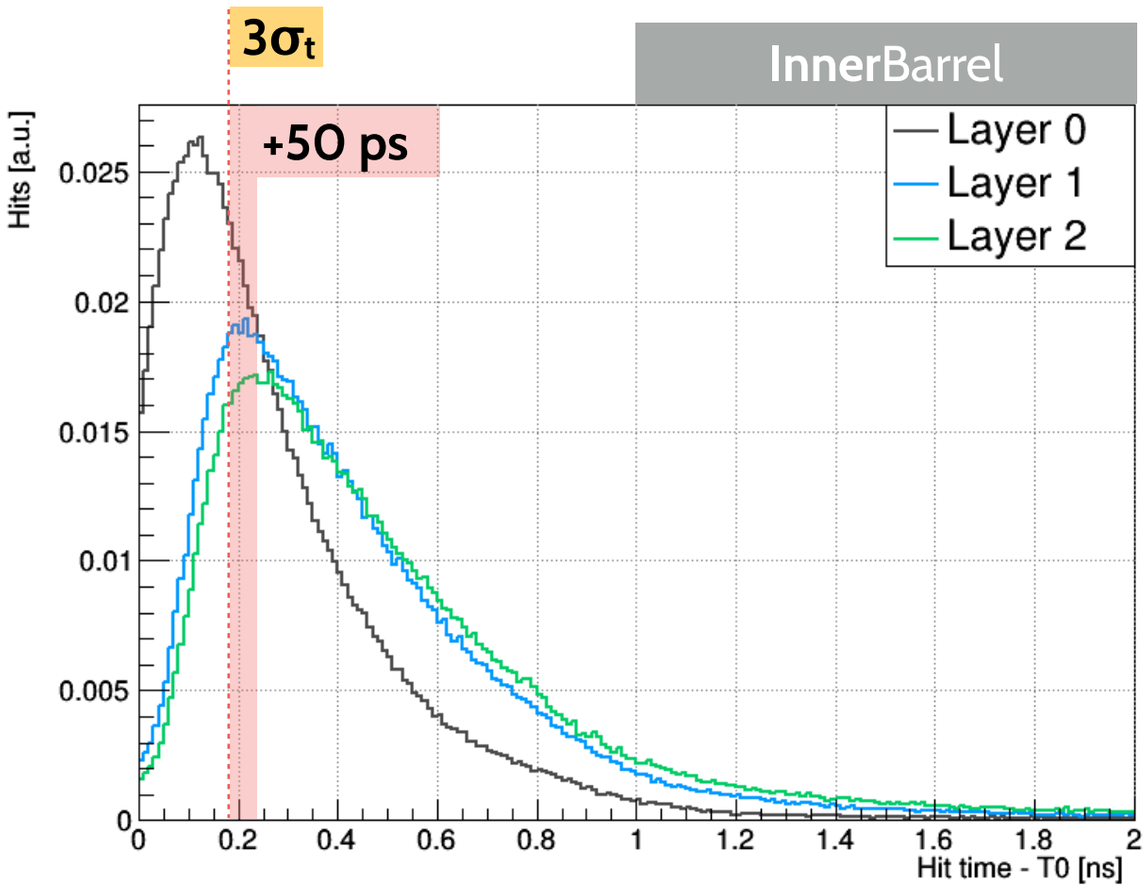


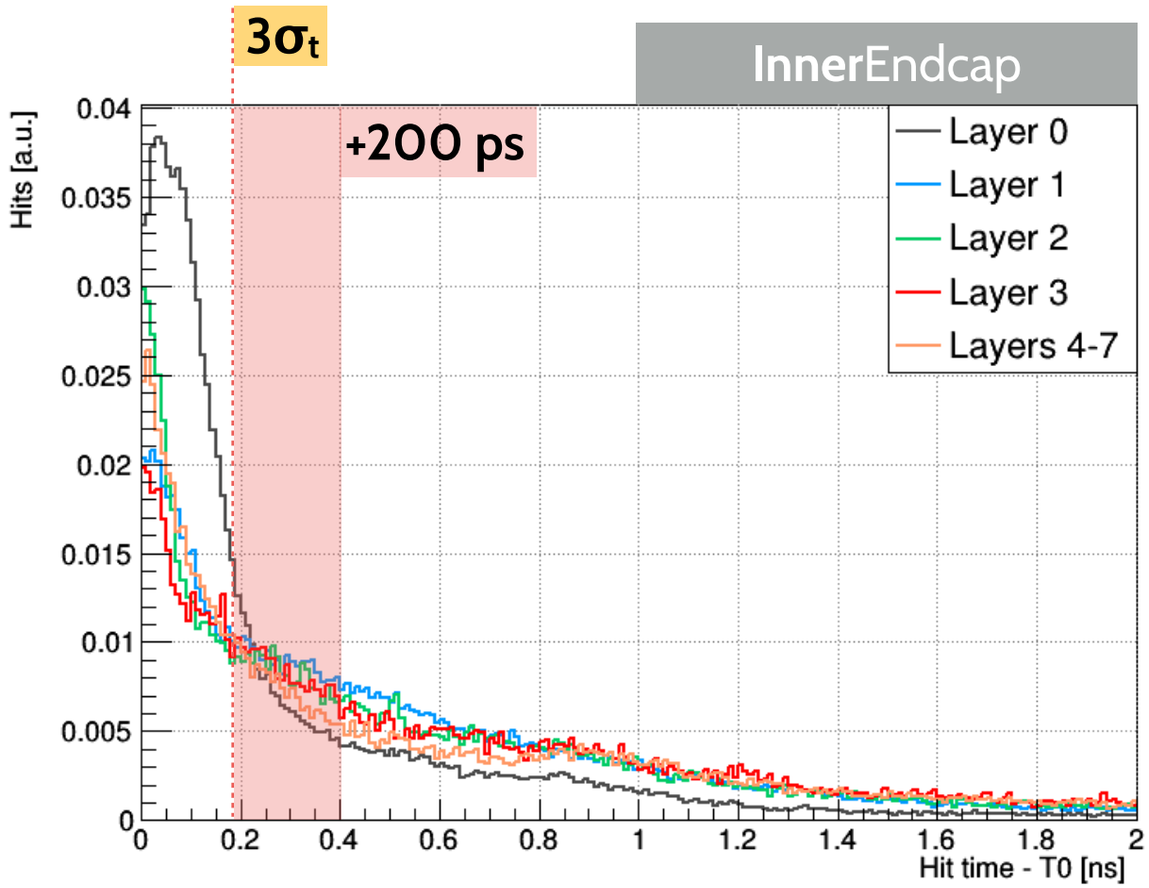
Implications: Inner Tracker

We should take the particle's TOF into account when setting the timing cuts

↳ decide on the lowest momentum of the heaviest particle we want measure

Expand the asymmetric time windows to include the hits from slower particles





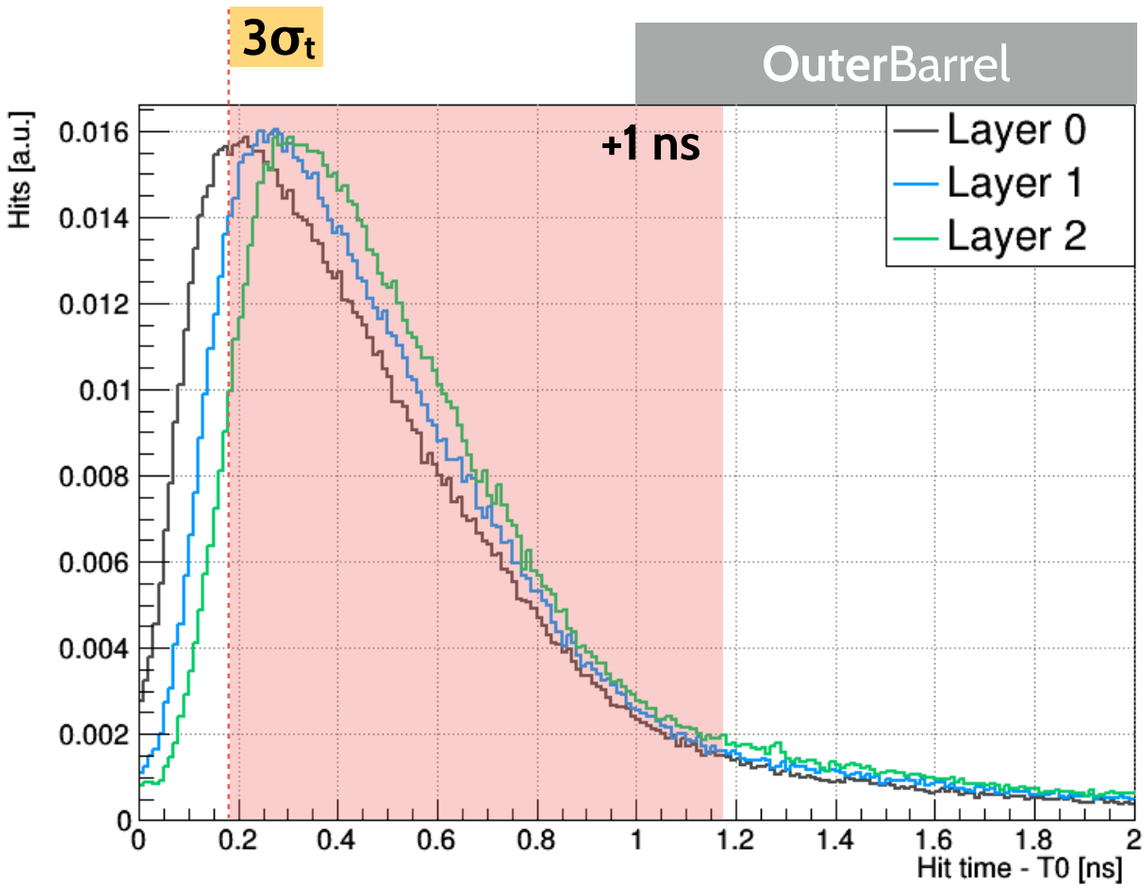
No dramatic increase in the number of hits in the InnerTracker

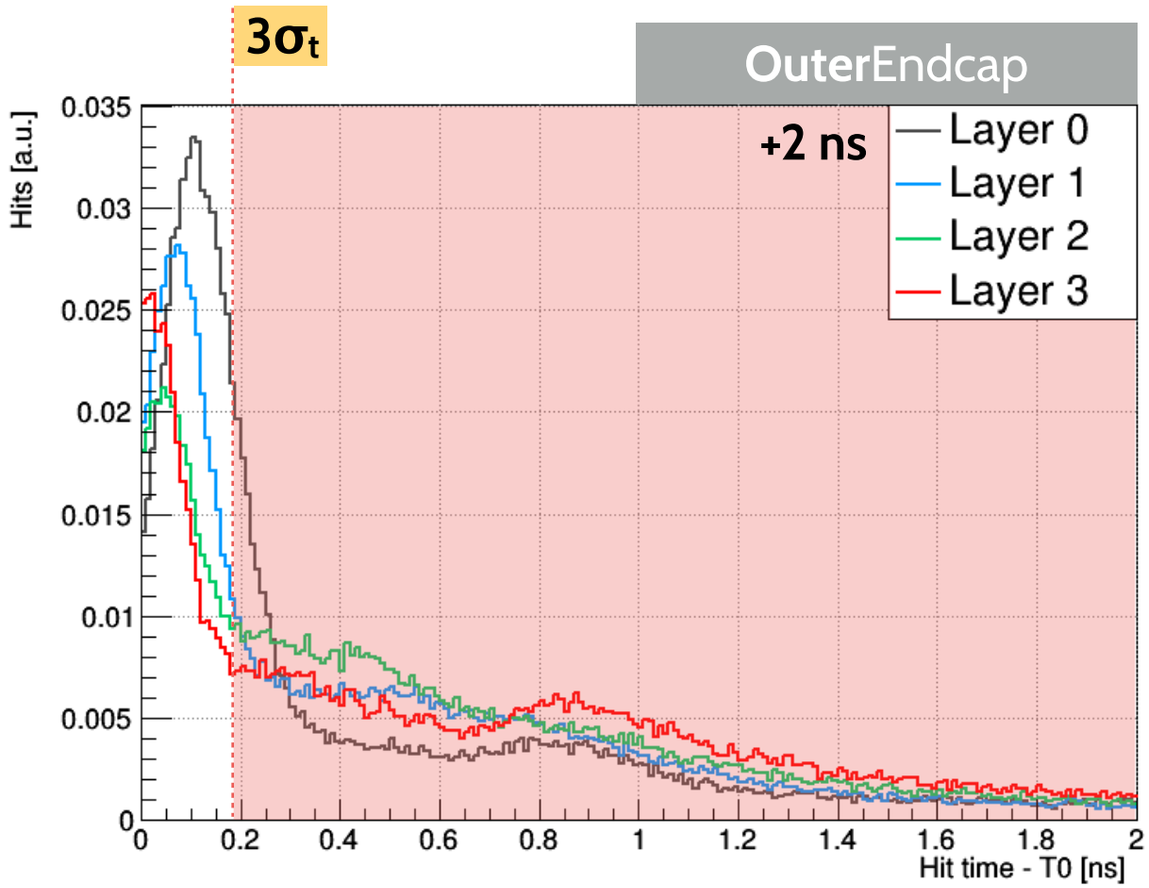
Implications: Outer Tracker

Quite a dramatic increase in the Outer Barrel if we want to keep slow particles

↳ to be taken into account in the tracker readout design, data rate, etc.

At $\sigma_t = 60ps$ we can use it as a TOF detector → use time in track reconstruction





We use Inner and Outer tracker only for extending track from the Vertex Detector

↳ **no big problem for the track reconstruction** (track p_T estimate is used)

Would be a problem if we decide to use the inverted track search

Conclusions

We have to consider the time of flight of particles that we plan to reconstruct with the Inner and Outer Trackers

We need to define specific benchmark particles and their kinematics to use for tracking efficiency estimations

We likely need to use asymmetric readout time windows to keep hits from slow particles

Track reconstruction should not be strongly affected by the increase in occupancy