Detector-1 proposal

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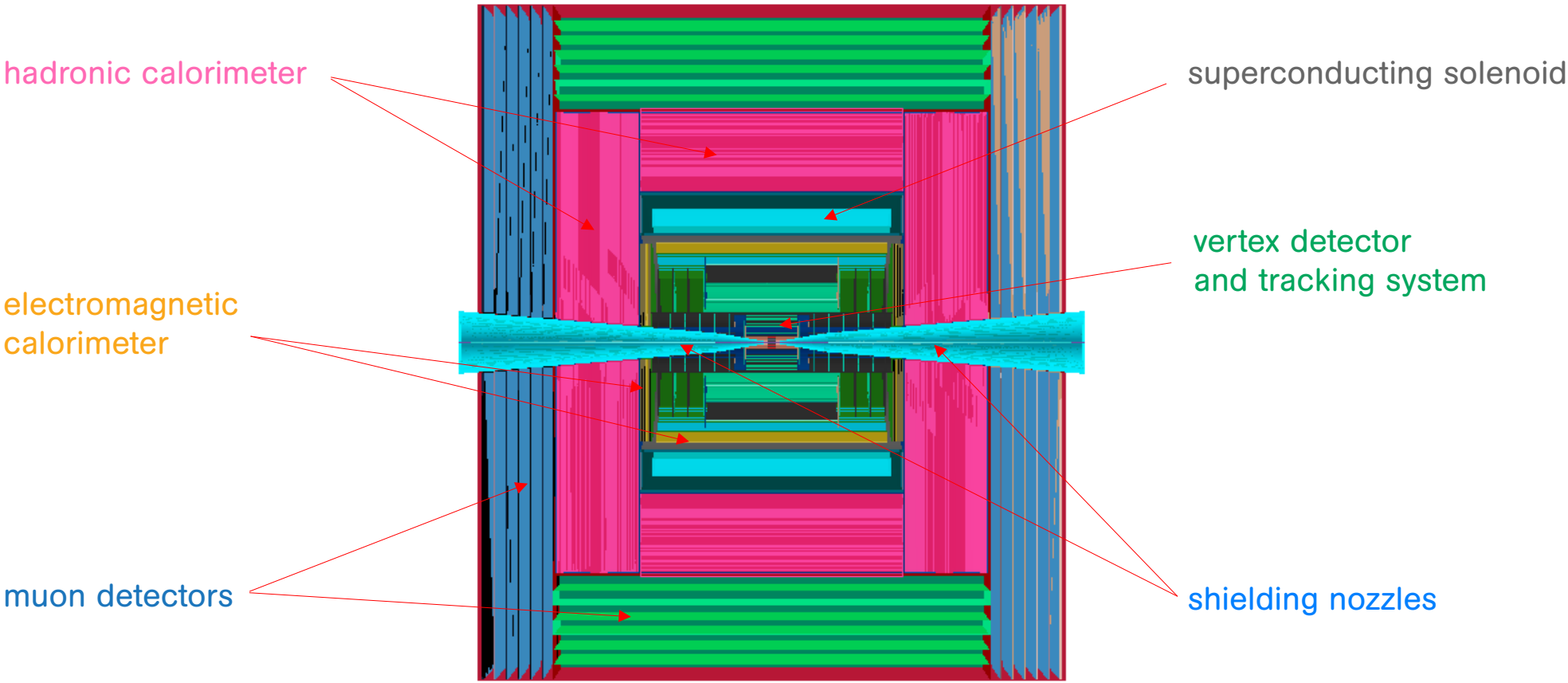
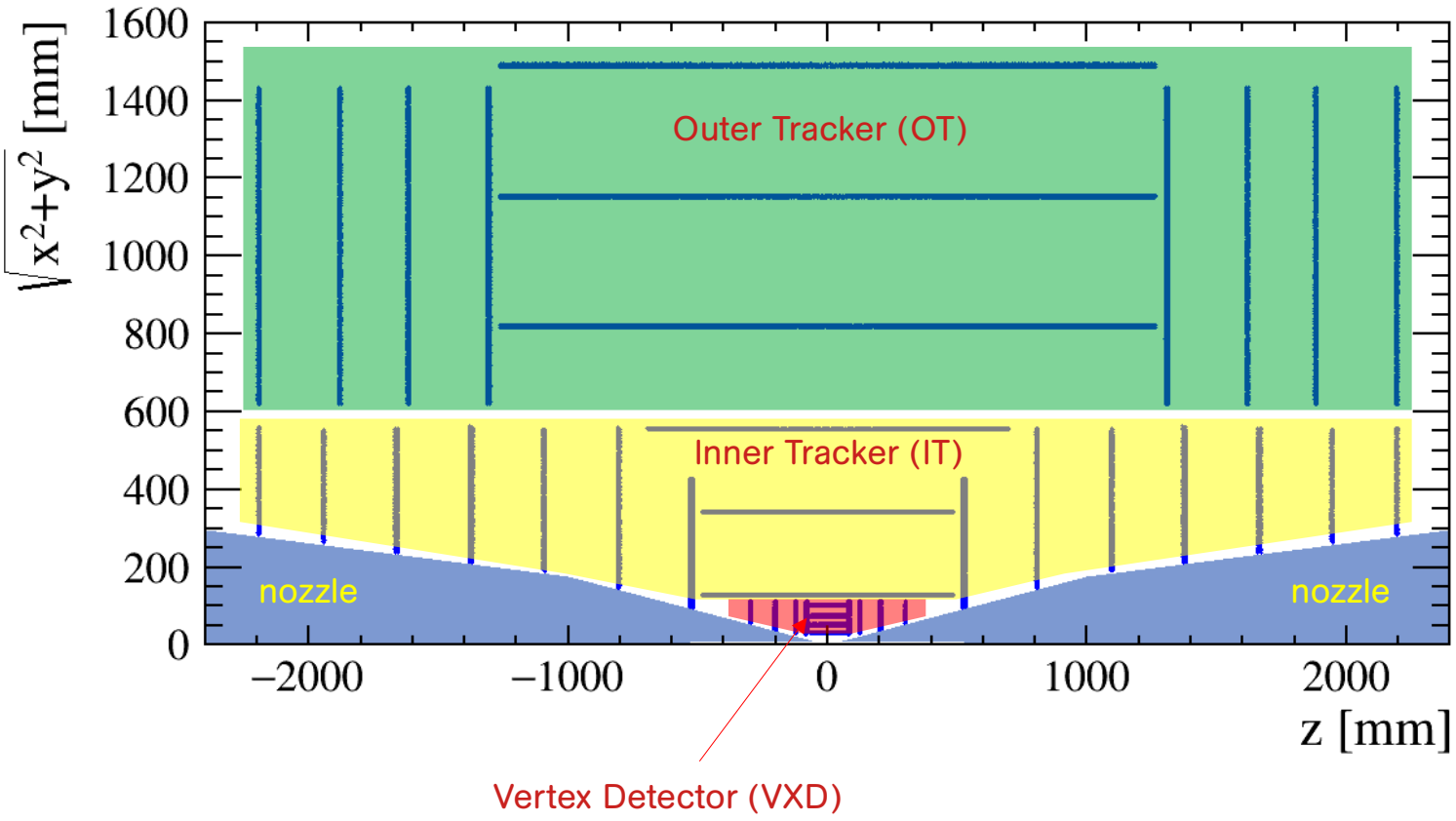
MUSIC detector layout



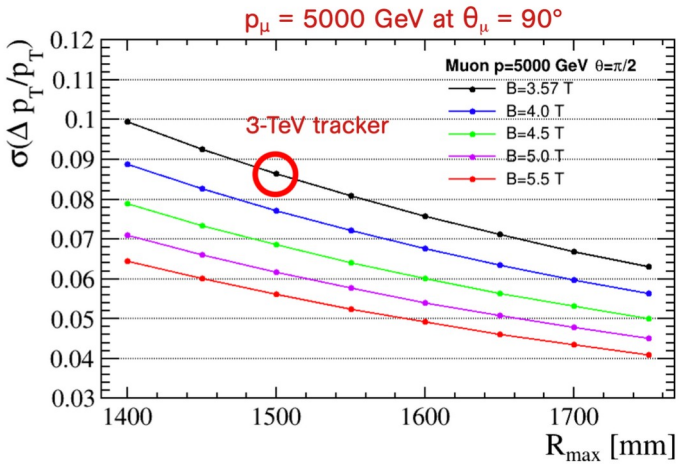
The MUSIC detector (Muon Smasher for Interesting Collisions).

Starting point: the 3 TeV tracking system



Tracking system configuration

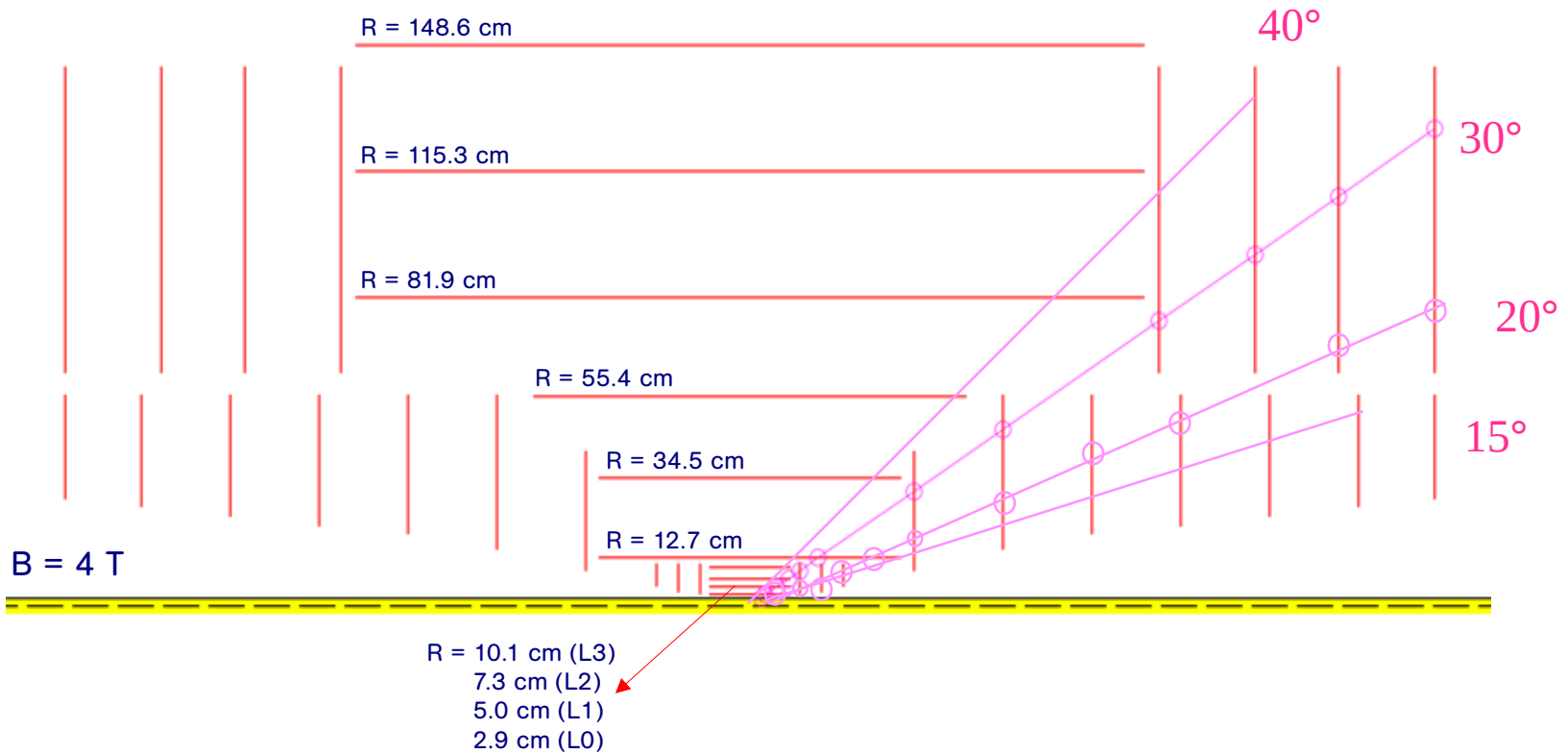
- Magnetic field value presumably between 4 and 5 T, final value to be defined.
- Tracker size:
  - same as 3 TeV tracker for the time being.
- Envisaged technologies:
  - small pixels in the VXD;
  - macro-pixels in the IT and OT.



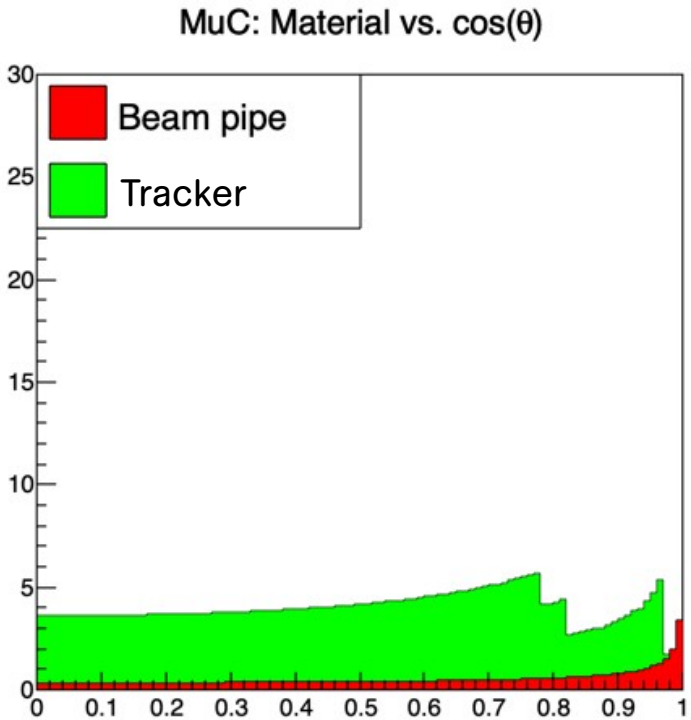
- Definition of an optimal layer layout studying different tracker configurations with the FastTrackCovariance package (written by F. Bedeschi and M. Selvaggi):
  - aiming to have ~10 hits per track over the entire θ range;
  - keeping the material budget as low as possible.

CLIC-like tracker: layout

- Changes:
  - VXD: increased barrel length from 13 to 26 cm and removed the two endcap disks closer to the barrel, removed VXD double layers.

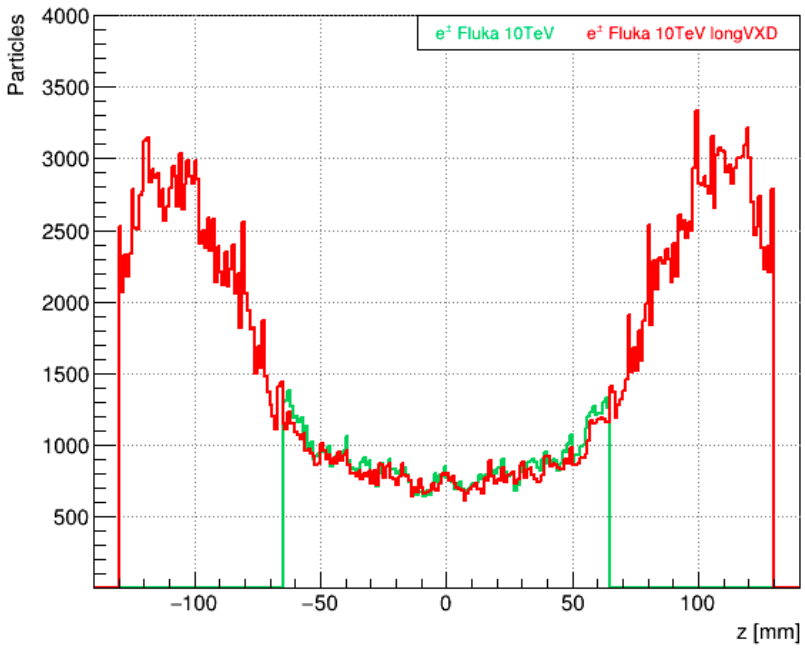


CLIC-like tracker: material budget

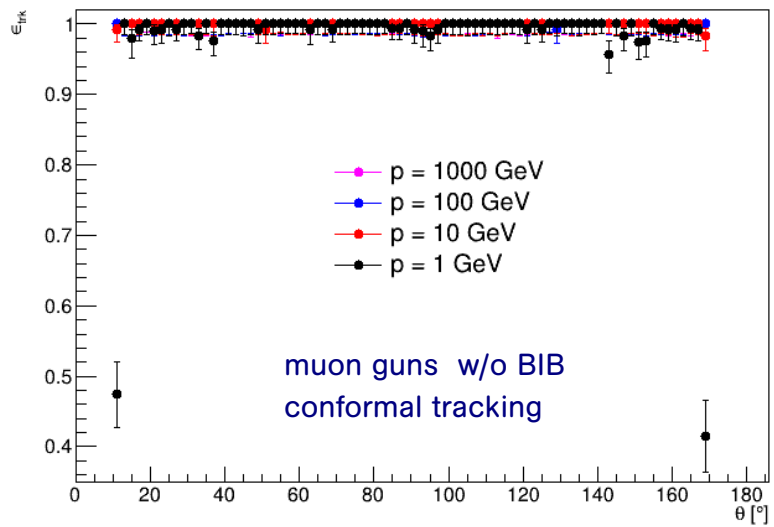


CLIC-like tracker: full-simulation checks

BIB simhits in the first VXD layer

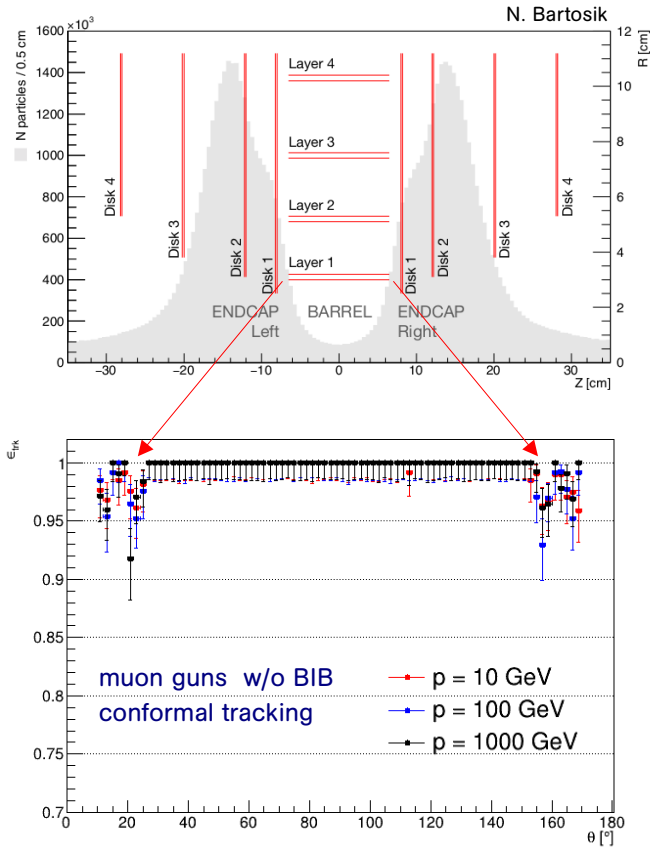


track reconstruction efficiency

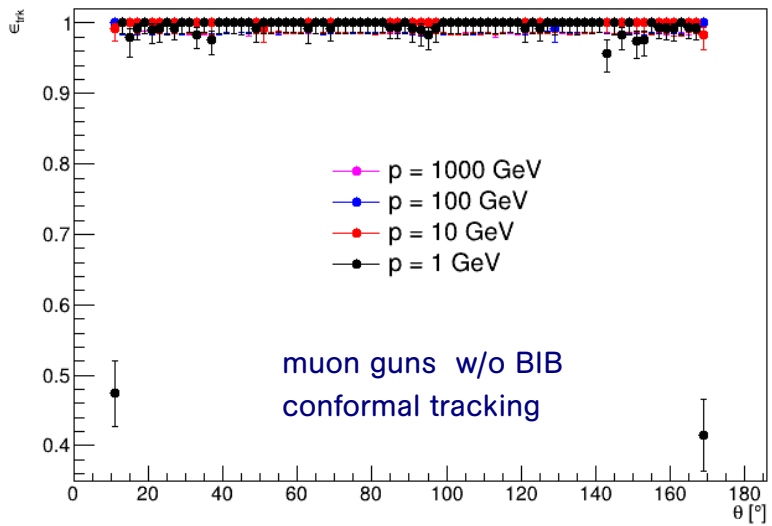


CLIC-like tracker: full-simulation checks

3 TeV vertex detector

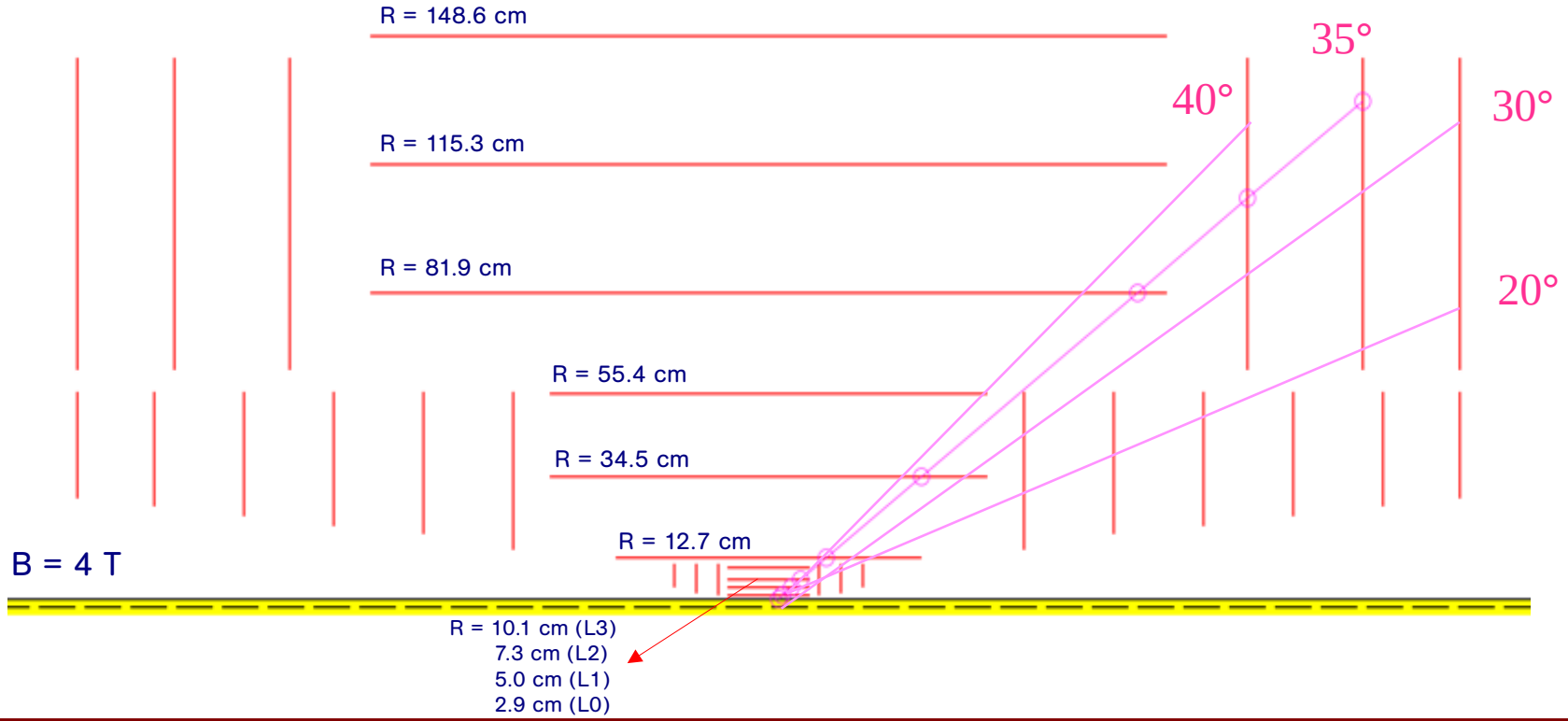


track reconstruction efficiency

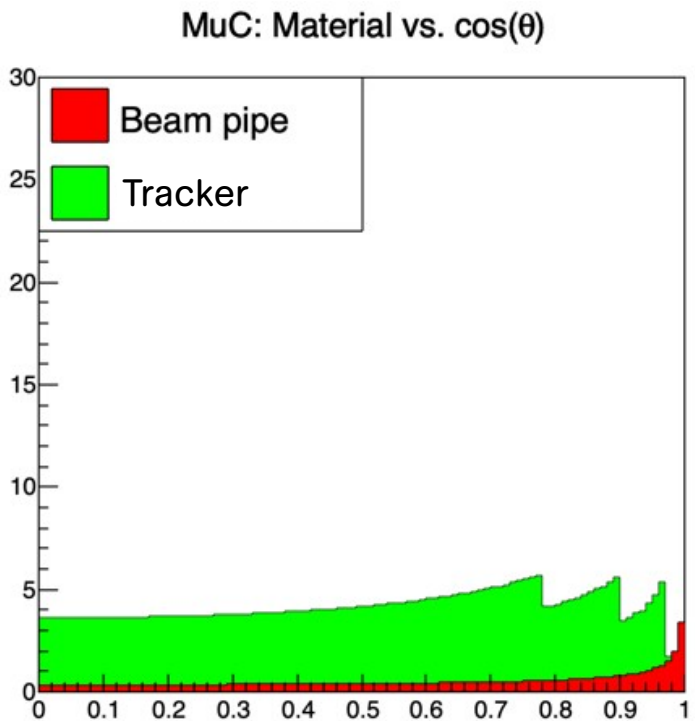


New configuration: layout

- Changes:
  - VXD: extended barrel length and removed double layers;
  - IT: extended 2nd barrel layer and removed endcap discs closer to the barrel;
  - OT: removed endcap discs closer to the barrel and adjusted positions of 2nd and 3rd discs.

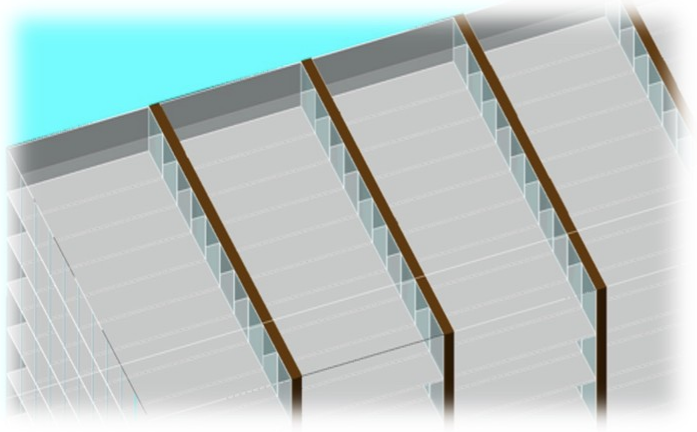


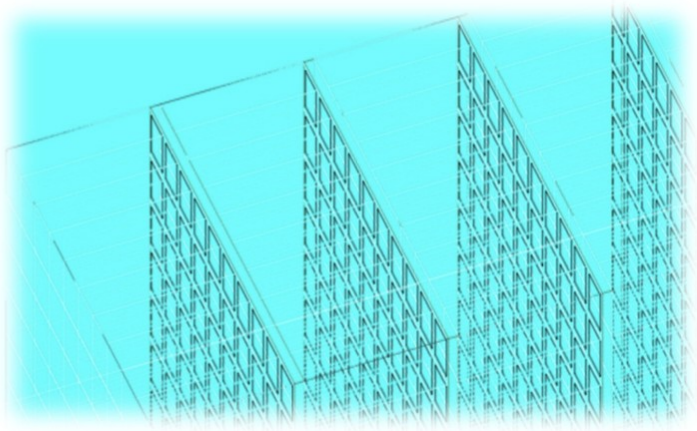
New configuration: material budget



CRILIN electromagnetic calorimeter

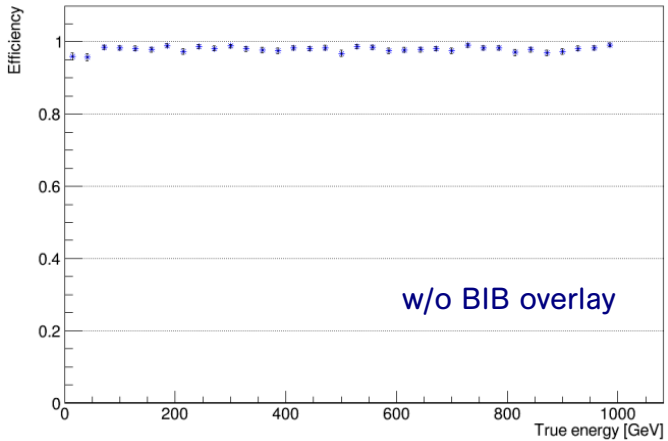
- CRILIN (crystal calorimeter with longitudinal information) is a semi-homogeneous electro-magnetic calorimeter based on lead fluorite (PbF_2) crystals, read out by SiPMs:
  - modular architecture based on stackable submodules composed of matrices of PbF_2 crystals;
  - current layout: 5 layers of 10x10x40-mm^3 crystal matrices (22 X_0).
- CRILIN design is fully integrated in the MuonColliderSoft framework.



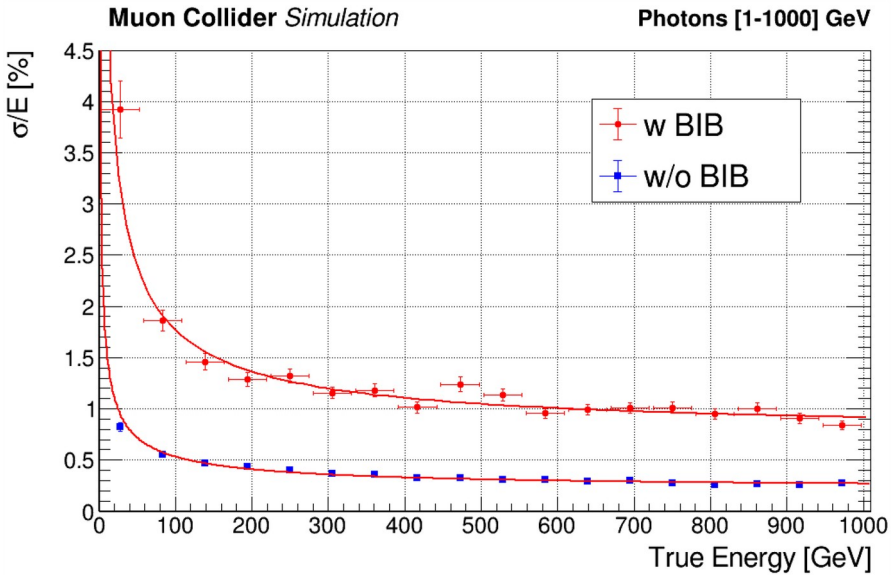


CRILIN current performance

photon reconstruction efficiency



photon energy resolution



Reconstruction software

- As the design of new detectors progresses, the reconstruction algorithms must keep pace with the newly introduced features.

- Ongoing efforts:
  - MuonColliderSoft moved to a more recent version of ACTS and tracker geometry changed → ACTS retuning needed.
  - Pandora ID of electrons under revision.

Backup

3 TeV detector concept

hadronic calorimeter

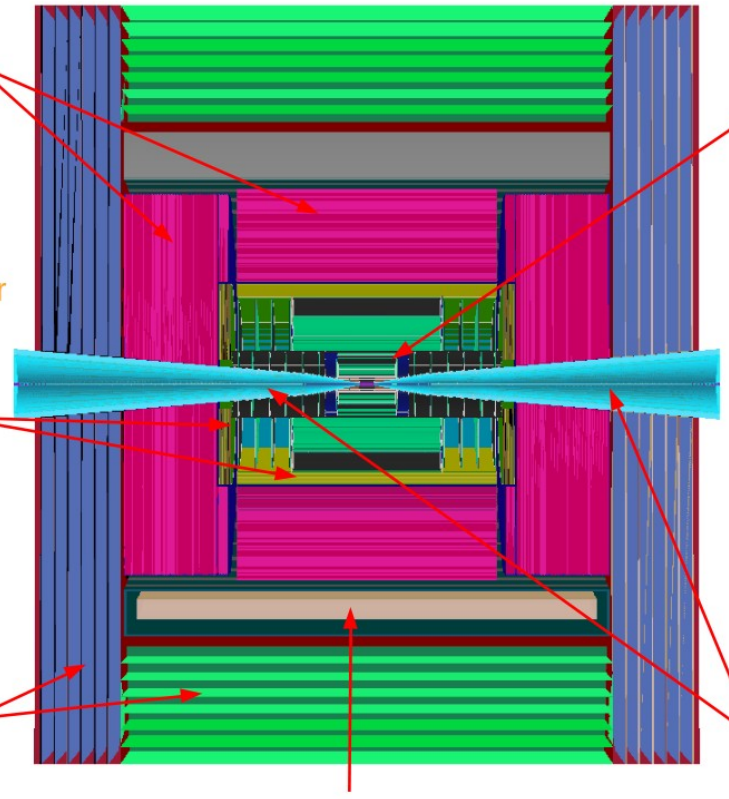
- 60 layers of 19-mm steel absorber + plastic scintillating tiles;
- 30x30 mm^2 cell size;
- 7.5 λ_I.

electromagnetic calorimeter

- 40 layers of 1.9-mm W absorber + silicon pad sensors;
- 5x5 mm^2 cell granularity;
- 22 X_0 + 1 λ_I.

muon detectors

- 7-barrel, 6-endcap RPC layers interleaved in the magnet's iron yoke;
- 30x30 mm^2 cell size.



tracking system

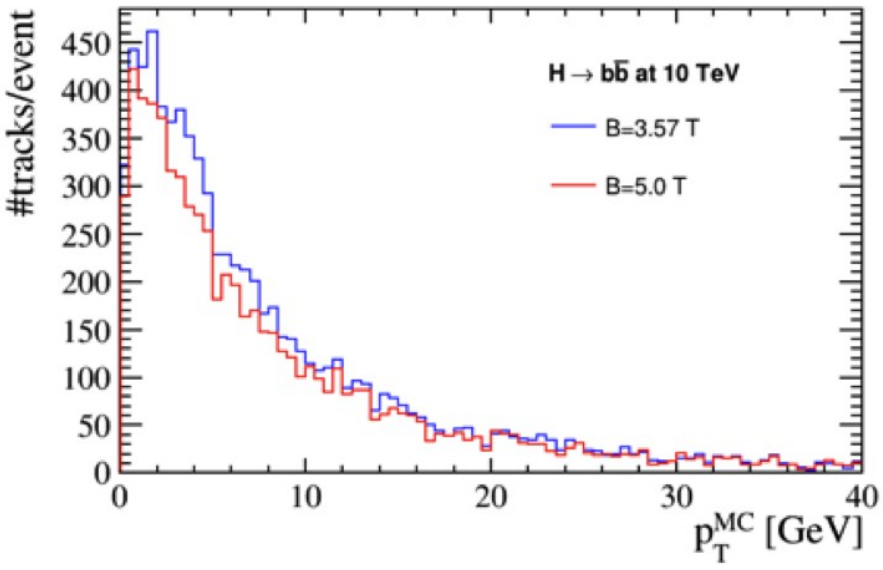
- Vertex Detector:
  - double-sensor layers (4 barrel cylinders and 4+4 endcap disks);
  - 25x25 μm^2 pixel Si sensors.
- Inner Tracker:
  - 3 barrel layers and 7+7 endcap disks;
  - 50 µm x 1 mm macro-pixel Si sensors.
- Outer Tracker:
  - 3 barrel layers and 4+4 endcap disks;
  - 50 µm x 10 mm micro-strip Si sensors.

shielding nozzles

- Tungsten cones + borated polyethylene cladding.

Particles in *b* jets from Higgs bosons

generator-level charged particles
inside the $H \to b\bar{b}$ jets



- Charged particles inside jets in $H \to b\bar{b}$ events have on average soft momenta, we can't afford to loose tracks with $p_T \sim 1$ GeV.
- Optimization of the magnetic field value seems necessary.