IMCC and MuCol annual meeting

Feedback from MUSIC detector studies for MDI design

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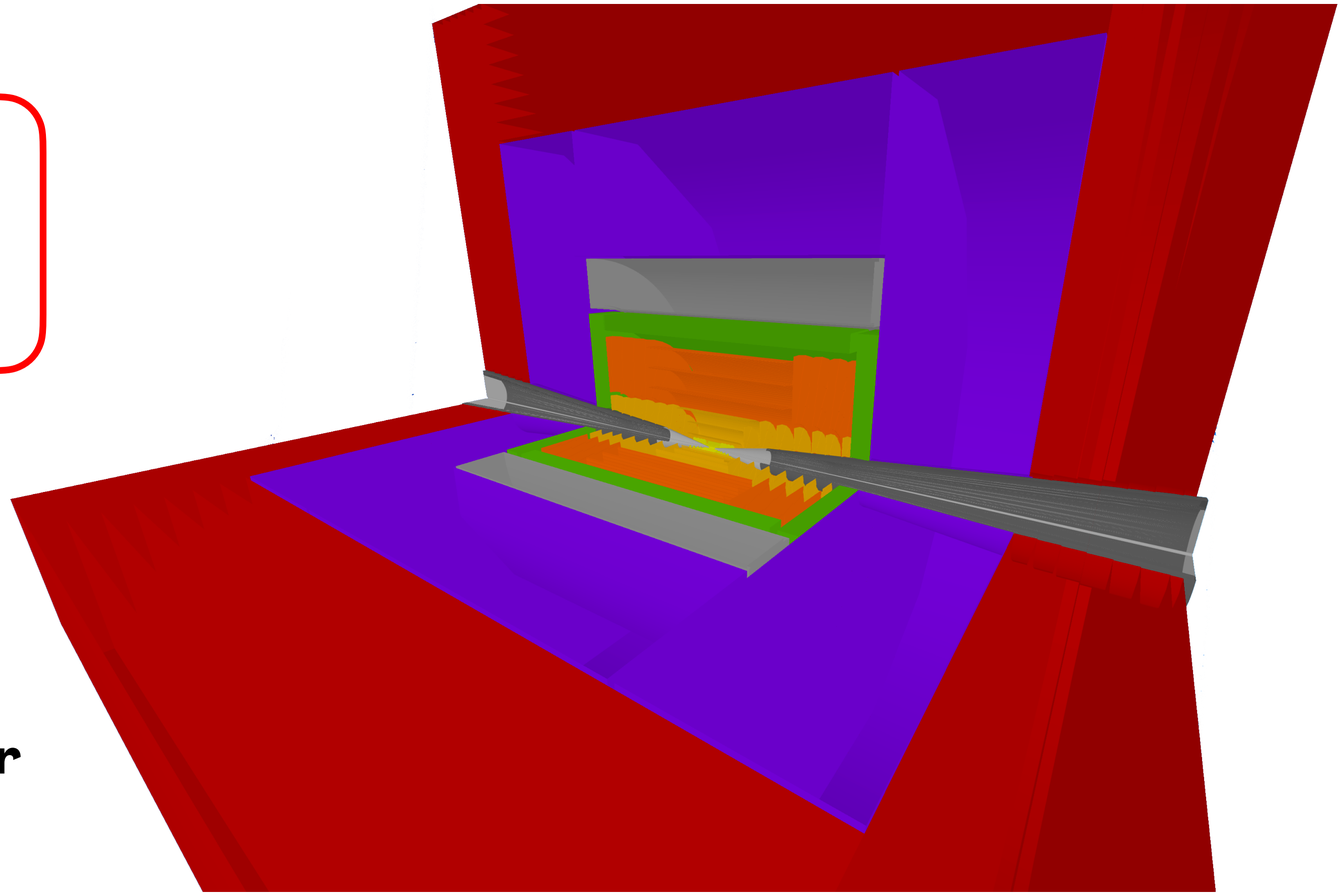
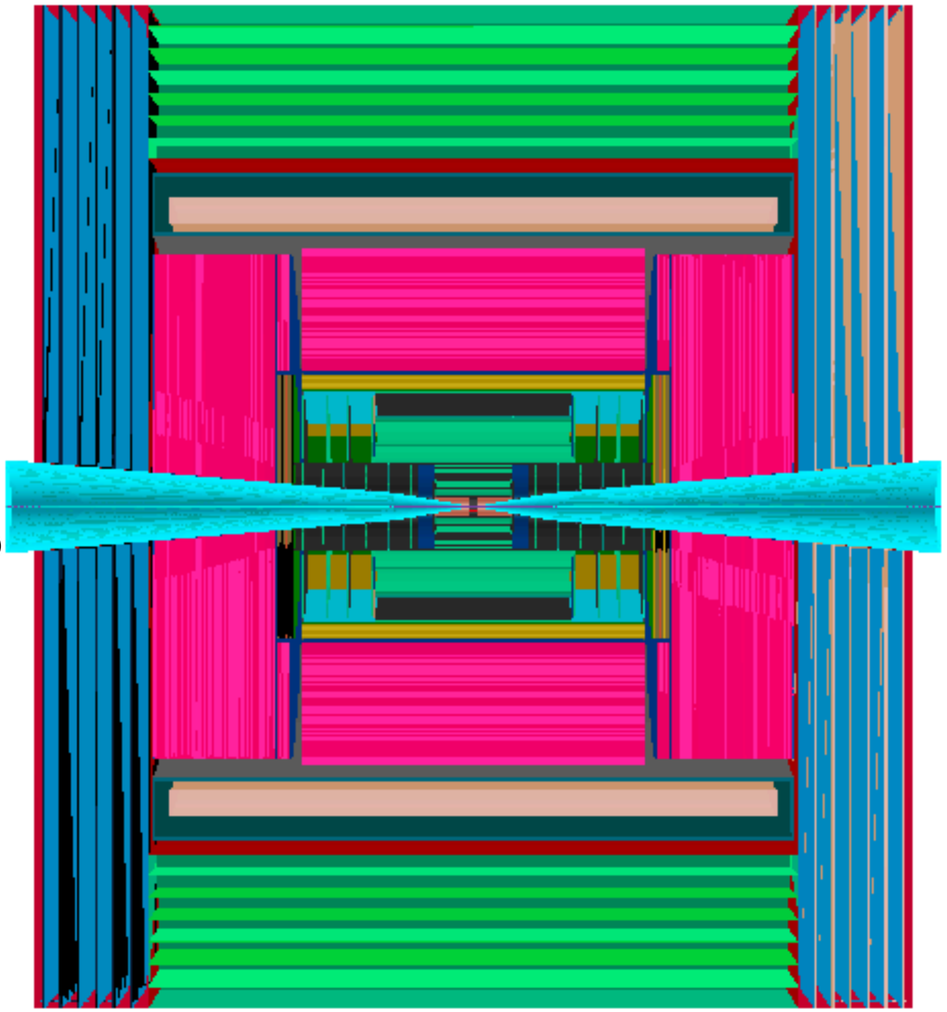
Introduction

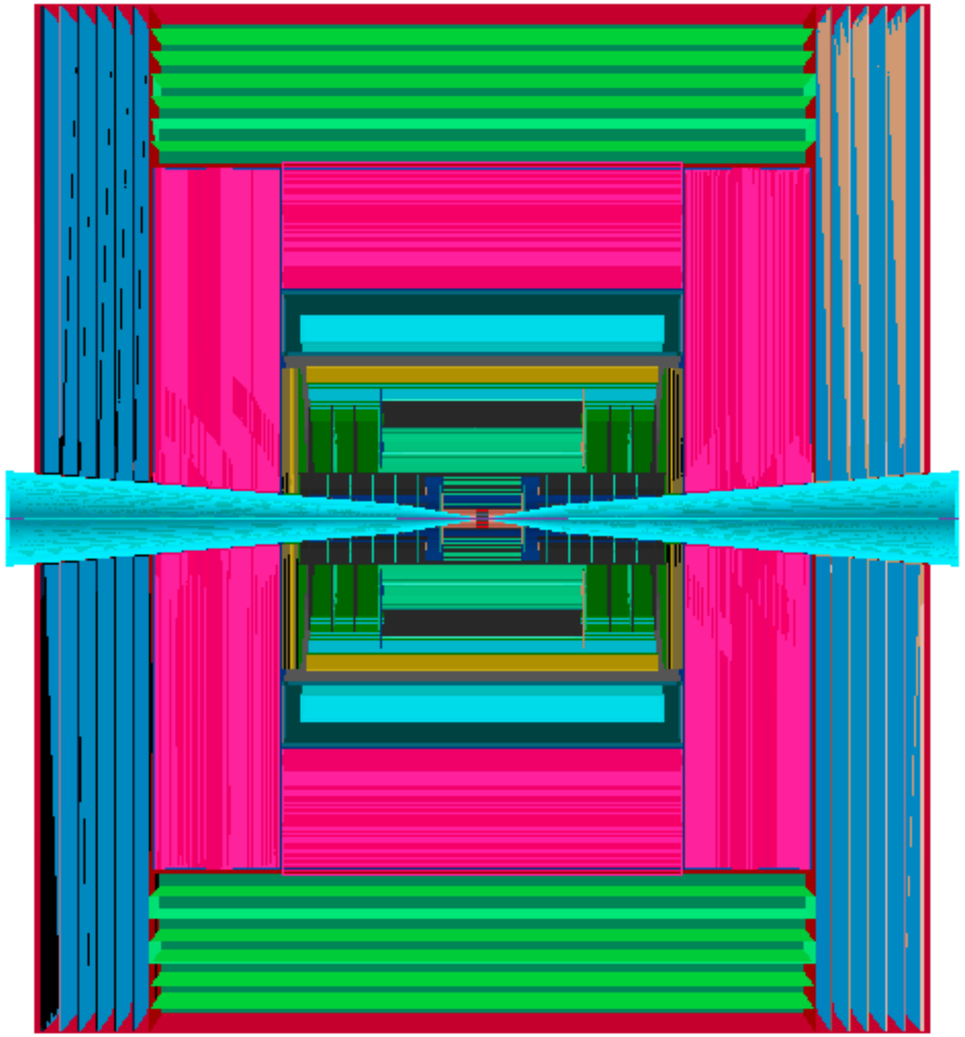
- Important effort in the last year, in particular:
  - Understanding the differences between Fluka and MARS frameworks
  - Assessment of BIB+IPP impact on detector
  - Reconstruction performance for different physics objects
- Question: **what did we learn?**
- Here: **some feedbacks from MUSIC detector point of view**



From where we started

MuColl_v1
(3 TeV configuration)

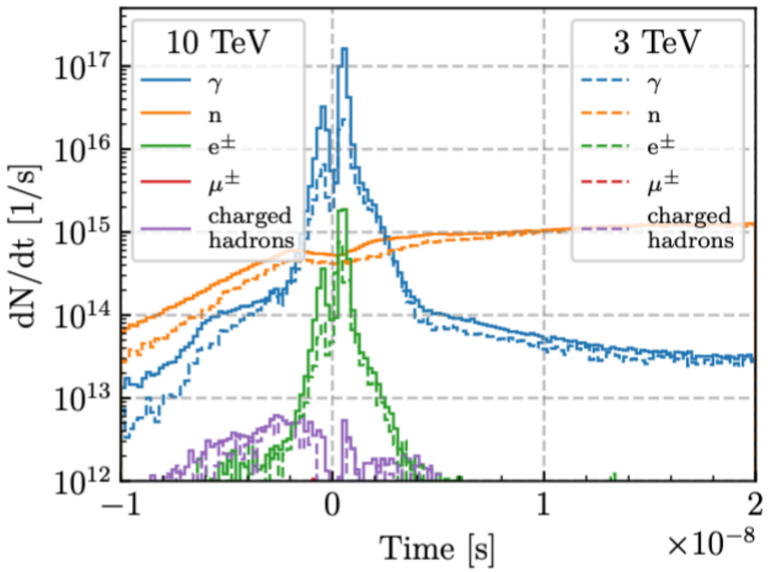


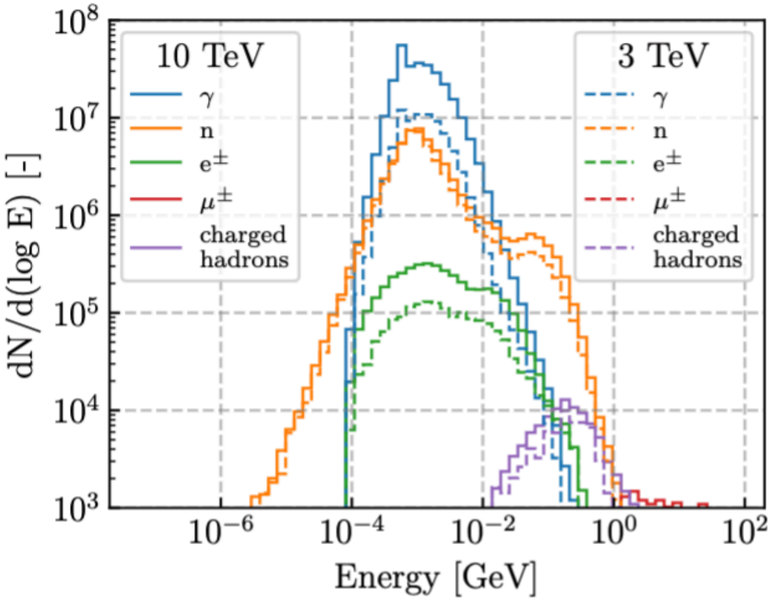


MUSIC

Change from 3 to 10 TeV

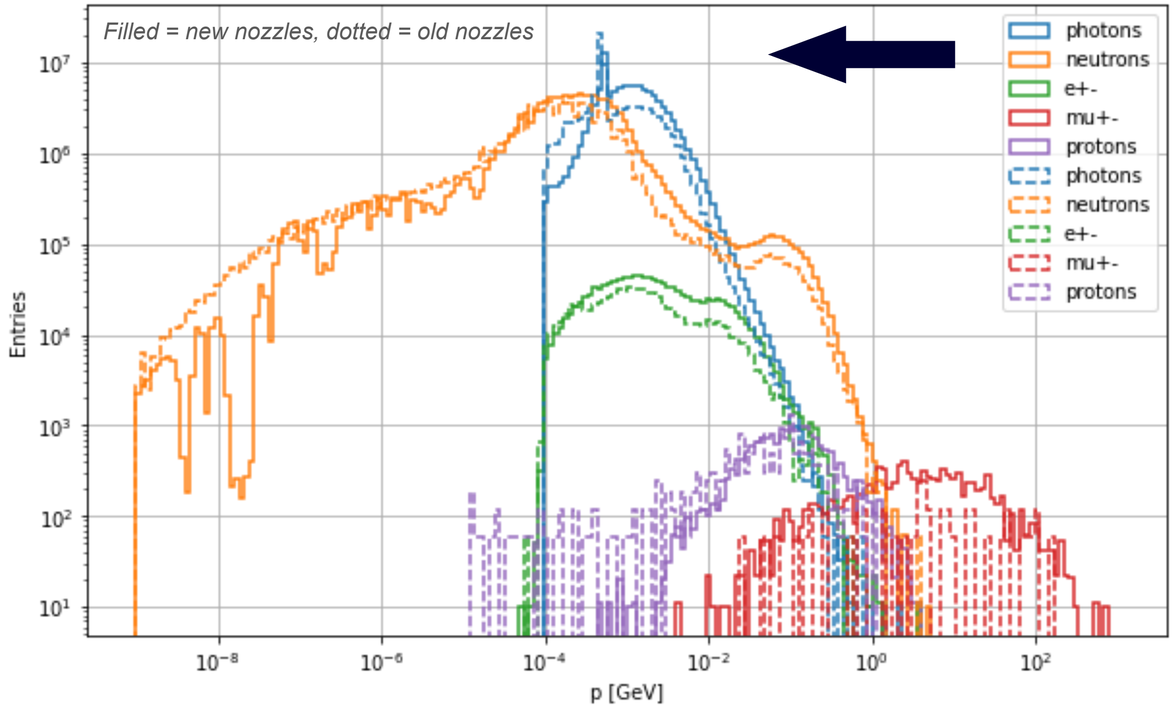
- First of all, change from 3 to 10 TeV has been not negligible
- In particular:
  - **More energetic** photons and electrons
  - **More** photons and electrons **on time** w.r.t. bunch crossing
  - Also, IPP now are present and not negligible

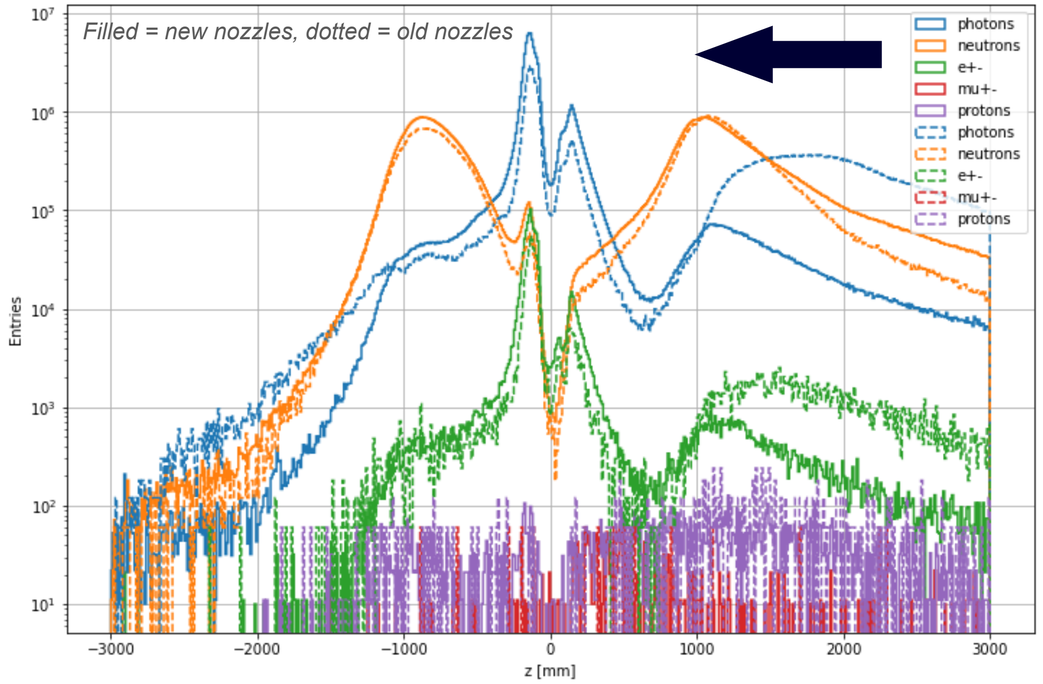




Change from v0.4 to v.08 lattices

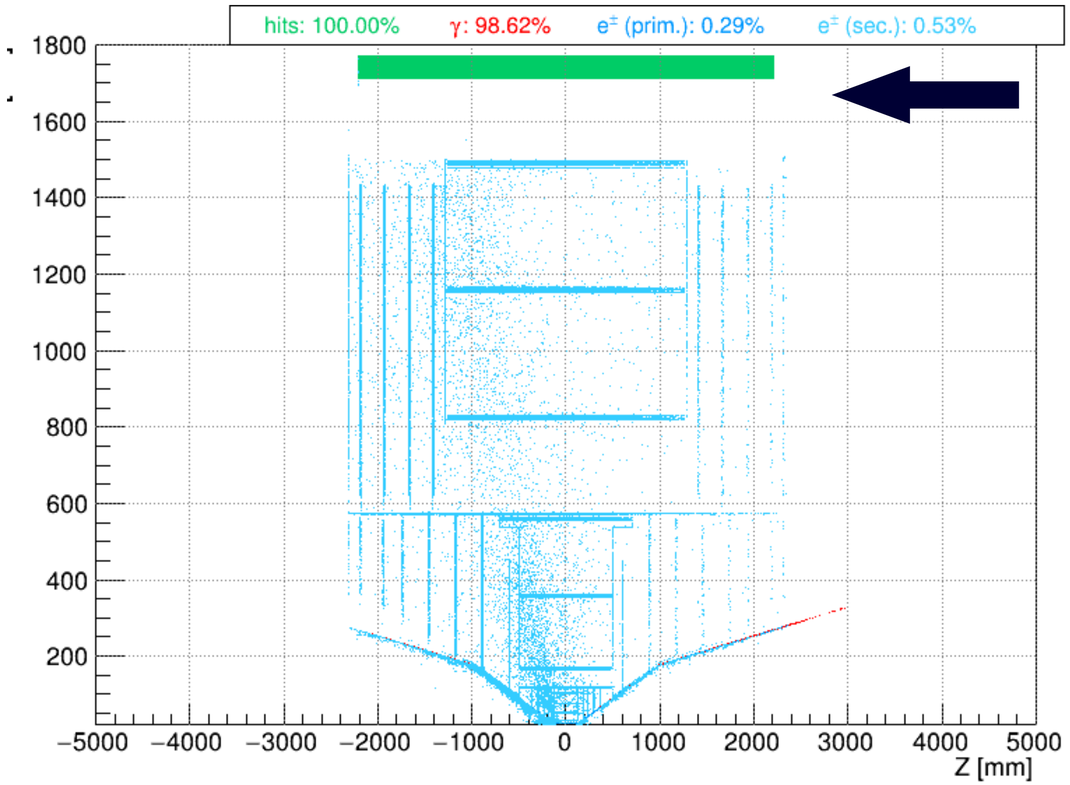
- Changes to last lattice version has not been “painless”
  - **Increase** in number of photons close to interaction point
  - **More energetic photons** and **neutrons**

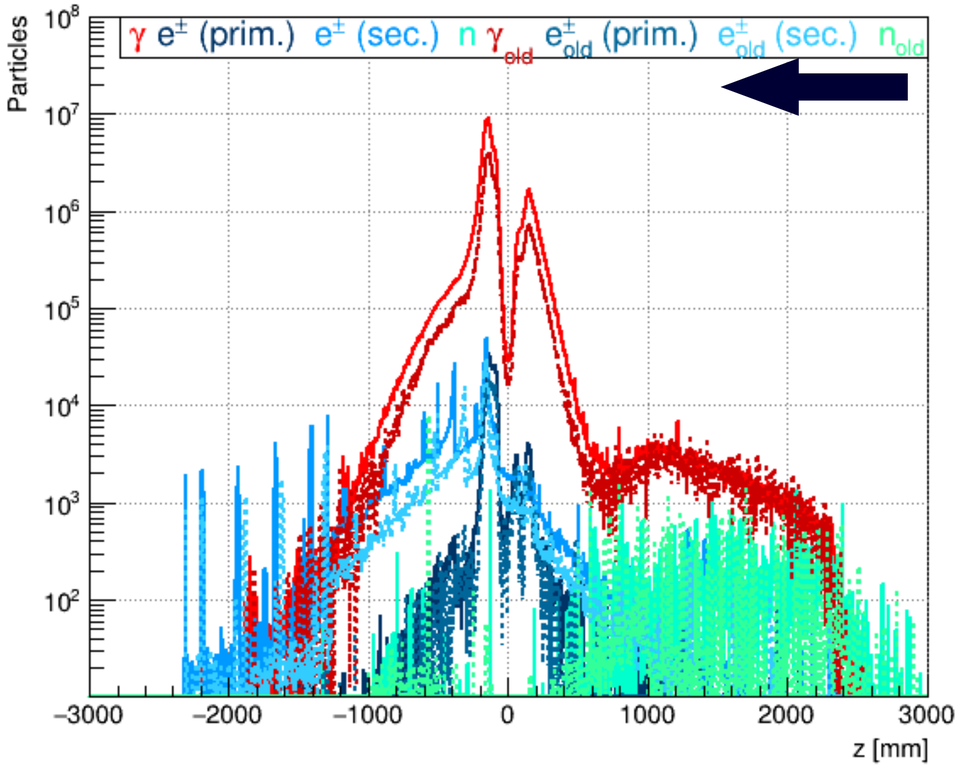




What happens in the detector?

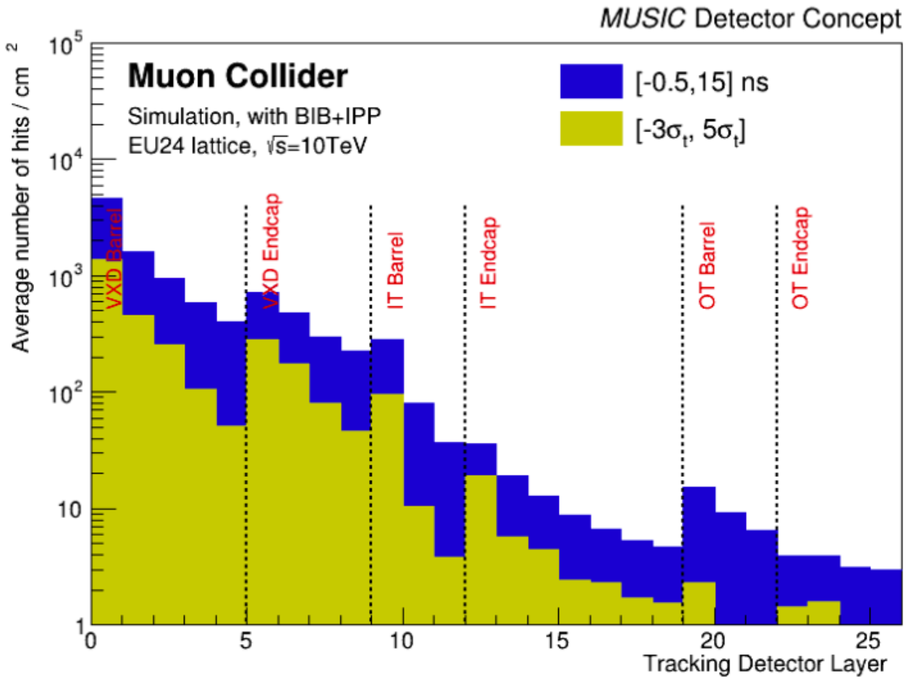
- Let’s have a look at particles generating hits in the ECAL
- Mainly primary photons exiting from the tip of the nozzles

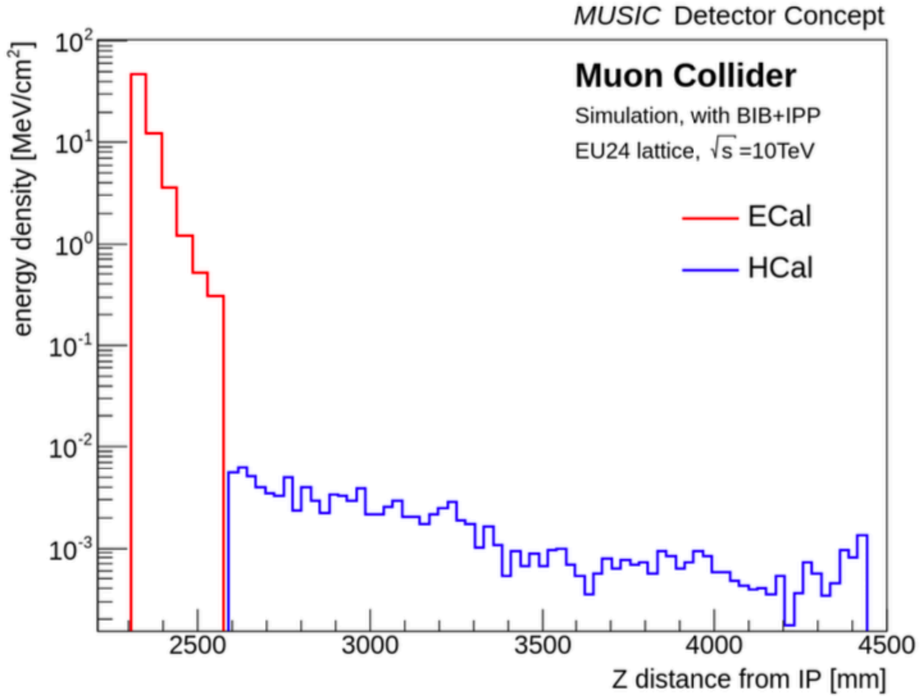




What happens in the detector?

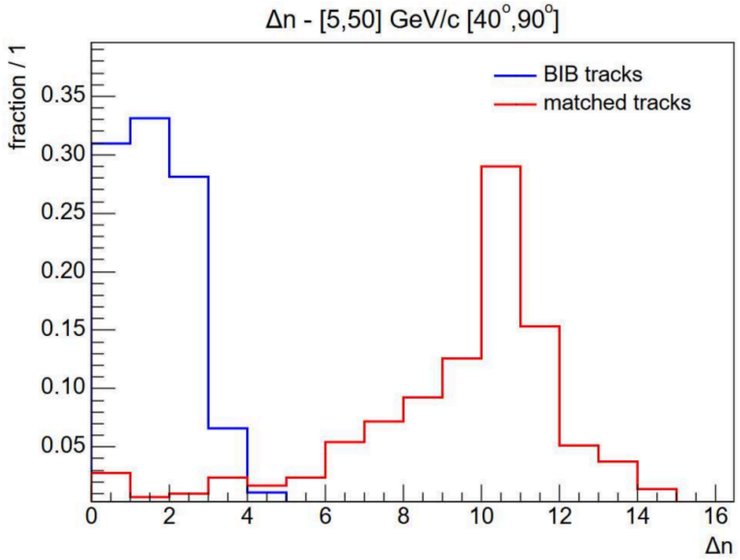
- Very naively:
  - Increase in occupancy in the tracker
  - Higher diffuse background in the calorimeters (particularly ECAL)

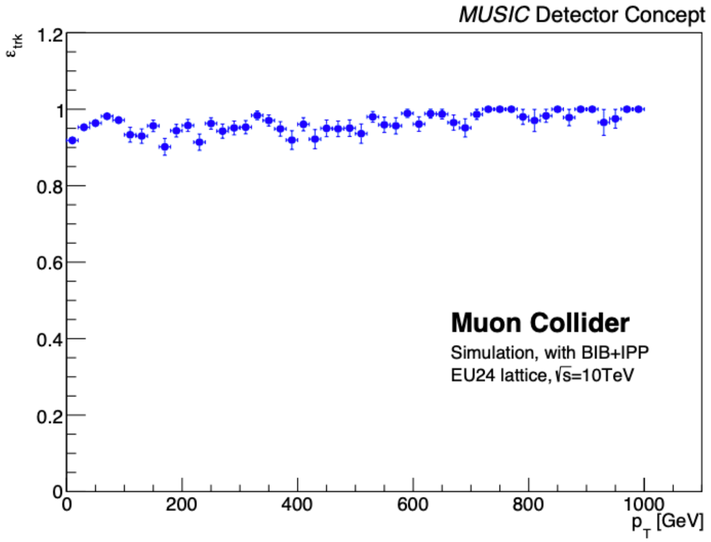


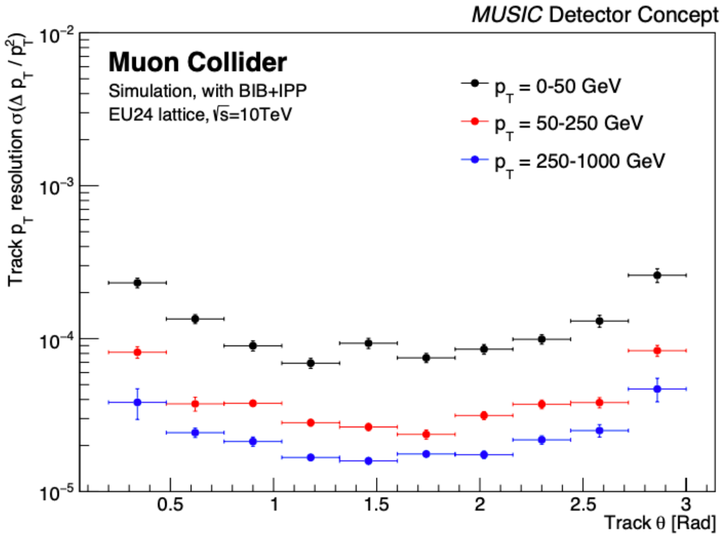


Tracker

- Old ACTS tuning was completely unsustainable
  - Tune ACTS in a better way, getting rid of the first VXD layer to perform seeding
  - Important parallelisation of algorithmsAnyway, huge number of tracks per event (~1M)
  - Important to find interesting figures of merit to filter tracks

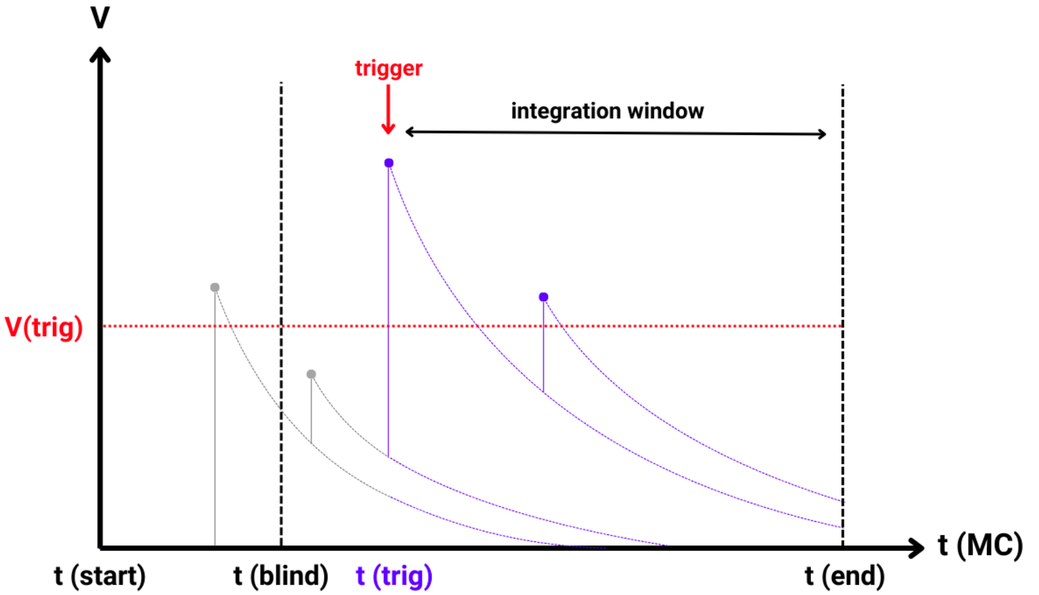


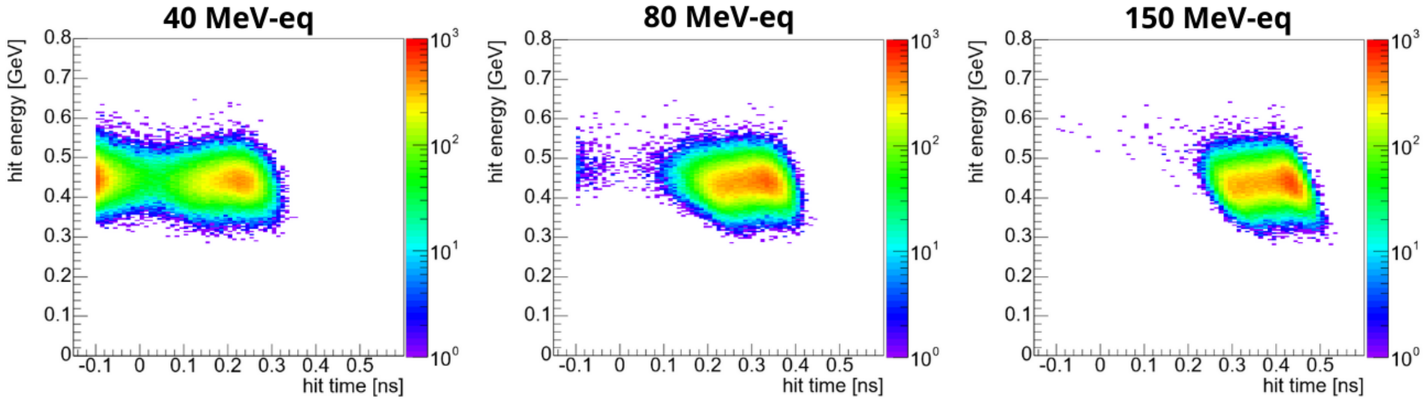


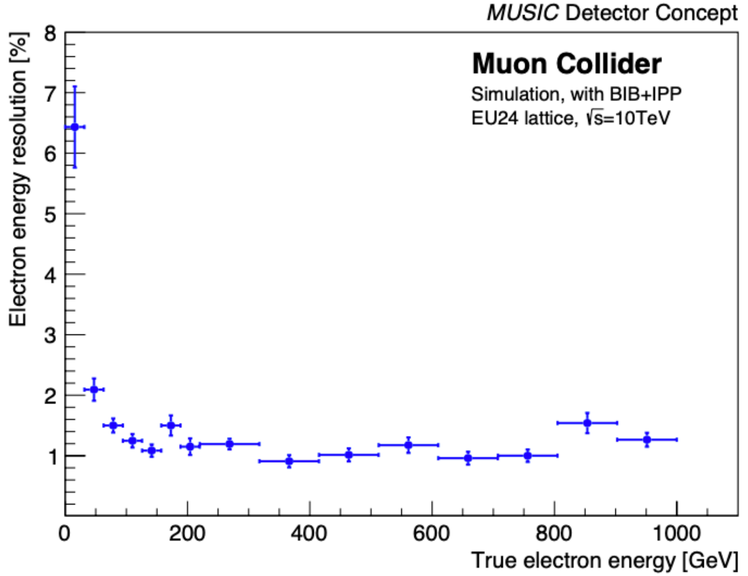


ECAL

- Given the increase in photons, reconstruction in ECAL has become challenging
  - We implemented a signal-threshold digitisation based on hit arrival time and energy
    - Depending also on ECAL region and layer
  - Tuning of hit clustering algorithm by PandoraPFA
- Able to get the same performance that were achieved in 3 TeV configuration







Conclusions

- Going from 3 TeV to 10 TeV, and from v0.4 to v0.8 lattice versions has changed the impact of BIB on detector
- Higher occupancies in the tracker and in ECAL
  - At the beginning it was **very difficult** to handle files and tools
- **New digi/reco techniques** and **tuning of algorithms** (ACTS and PandoraPFA) allowed us to get back to 3 TeV performance (sometimes even slightly better!)
- *(personal opinion)* Not so much we can do to improve further with present algorithms

- The most “problematic” region is close to the interaction point
- Is there something we can do about it?

Thank you for your attention!