# Detector performance studies

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# The roadmap

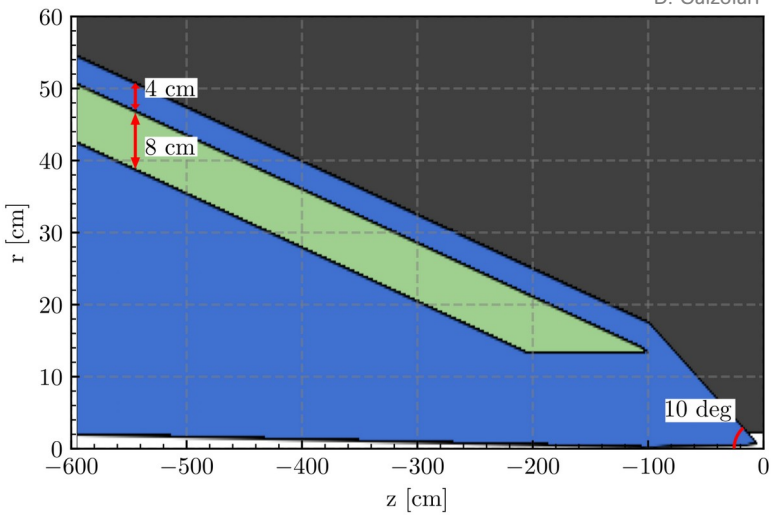
- Design of a new detector concept for μμ collisions at 10 TeV (MUSIC):
  - subdetector layout rearranged to accommodate deeper calorimeters;
  - tracker geometry optimized for a uniform coverage;
  - 5 T magnetic field;
  - new nozzles.

- Retuning/optimization of the reconstruction algorithms both at low- and high-level to cope with the machine-induced backgrounds (samples generated at 10 TeV with consistent machine lattice and MDI):
  - background from muon decays (BIB);
  - background from incoherent $e^+e^-$ pair production.

- Ongoing assessment of the reconstruction performance for main physics objects:
  - tracks;
  - photons and electrons;
  - jets and flavour tagging;
  - muons.

- Ultimate goal: use these objects on benchmark physics channels.

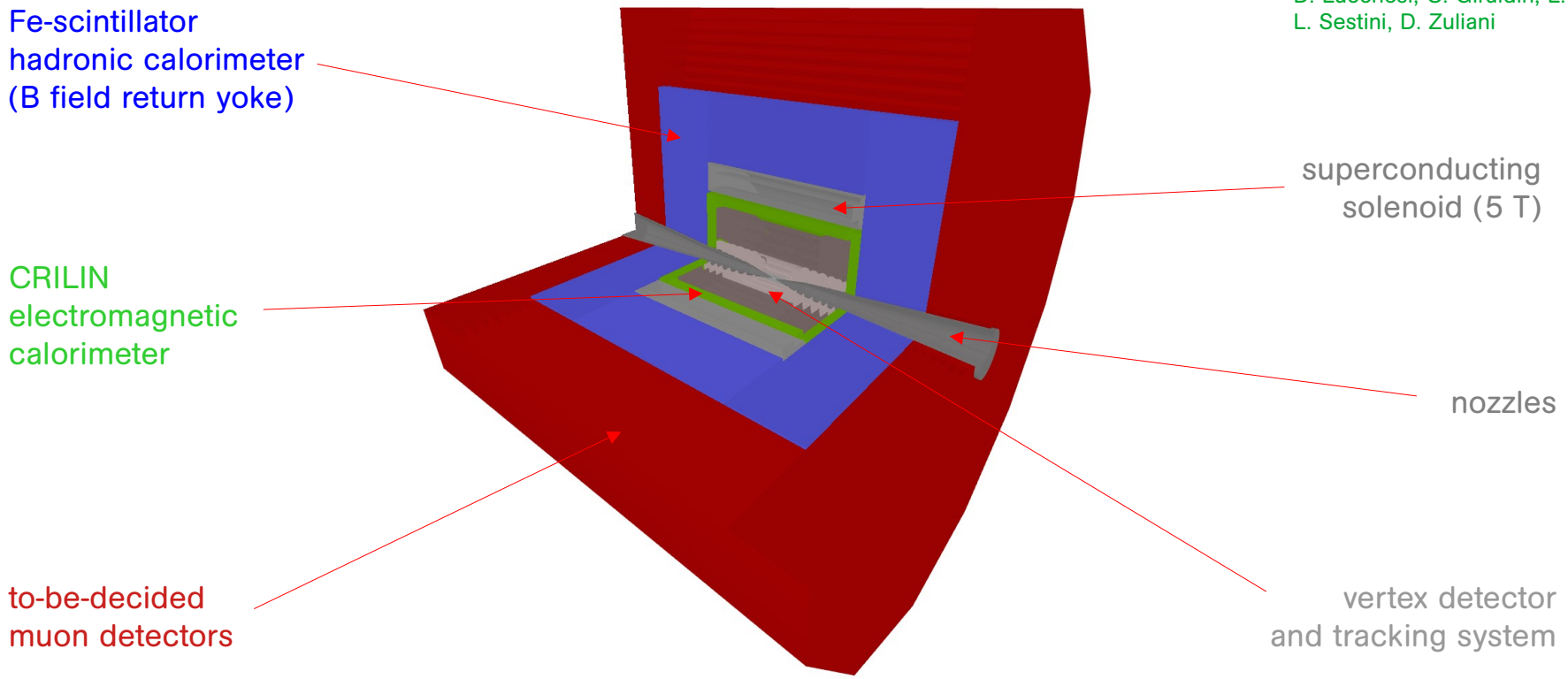
D. Calzolari




| 10 TeV | BIB | $e^+e^-$ pairs |
|---|---|---|
| **Photons** | 9.9E+07 | 4.0E+06 |
| **Neutron** | 1.1E+08 | 1.3E+05 |
| **e+/e-** | 1.2E+06 | 2.1E+05 |

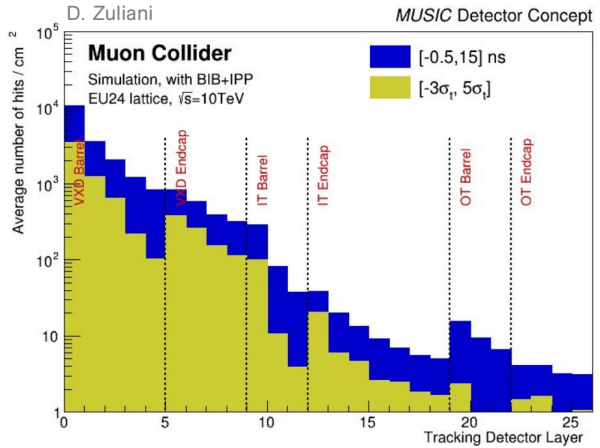
# The MUSIC detector concept

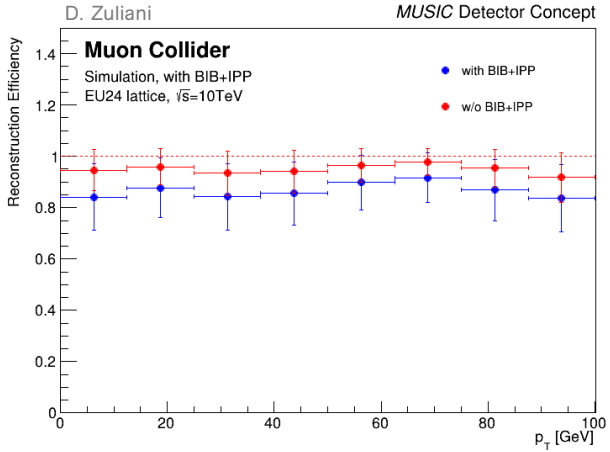
P. Andreetto, M. Casarsa, A. Gianelle,
D. Lucchesi, C. Giraldin, L. Palombini,
L. Sestini, D. Zuliani

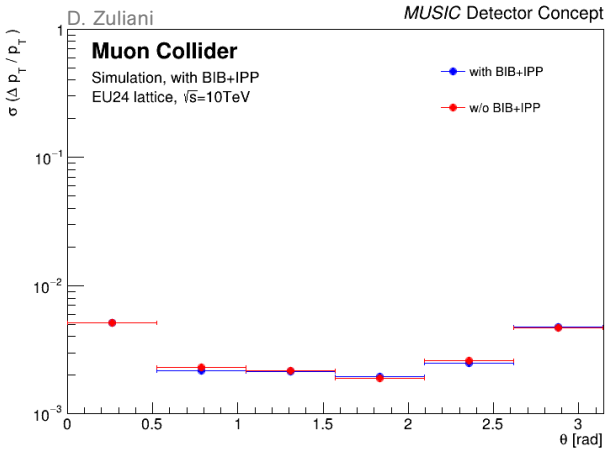


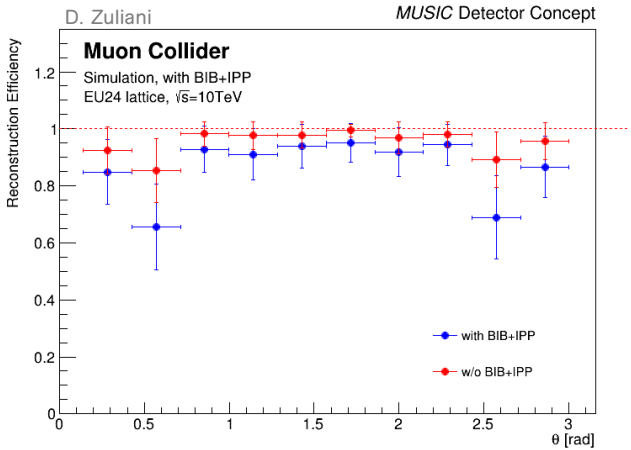

MUon System for Interesting Collisions

# Track reconstruction

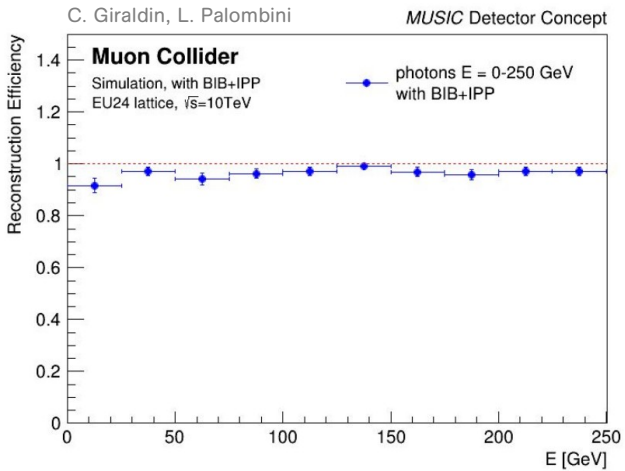


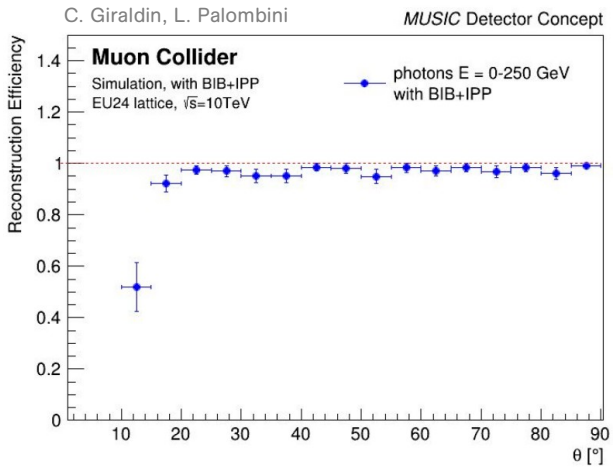



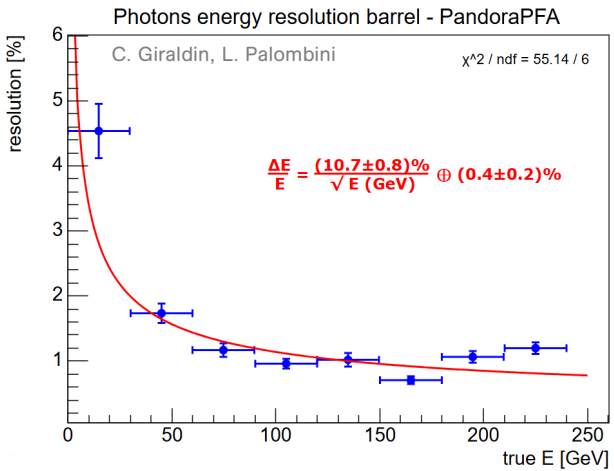



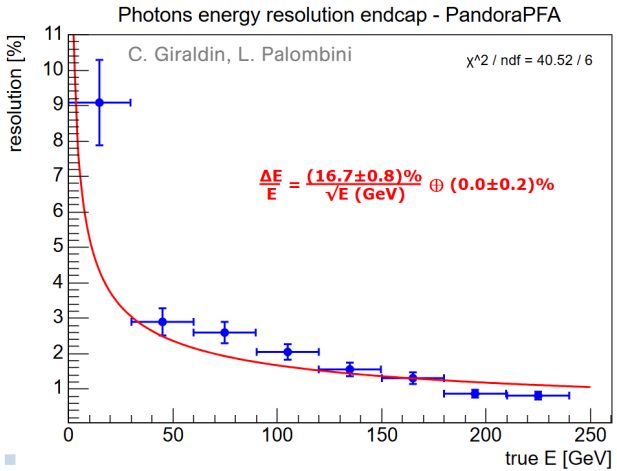



# Photon reconstruction

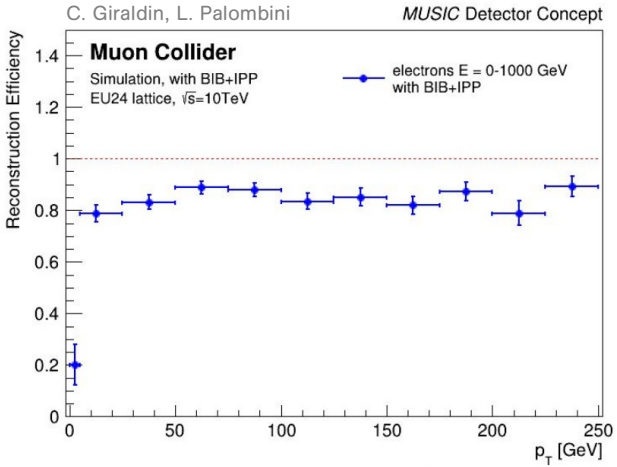


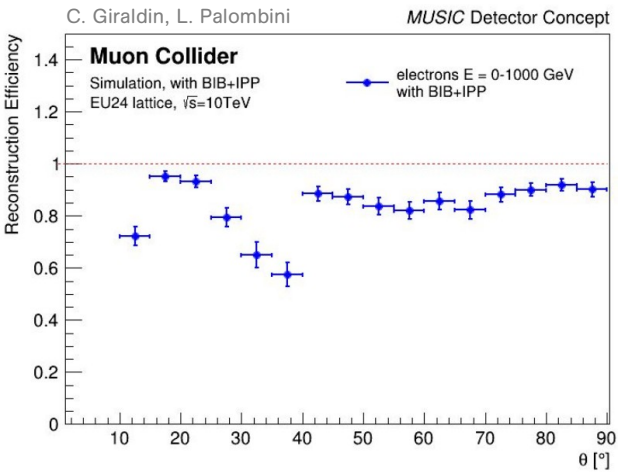



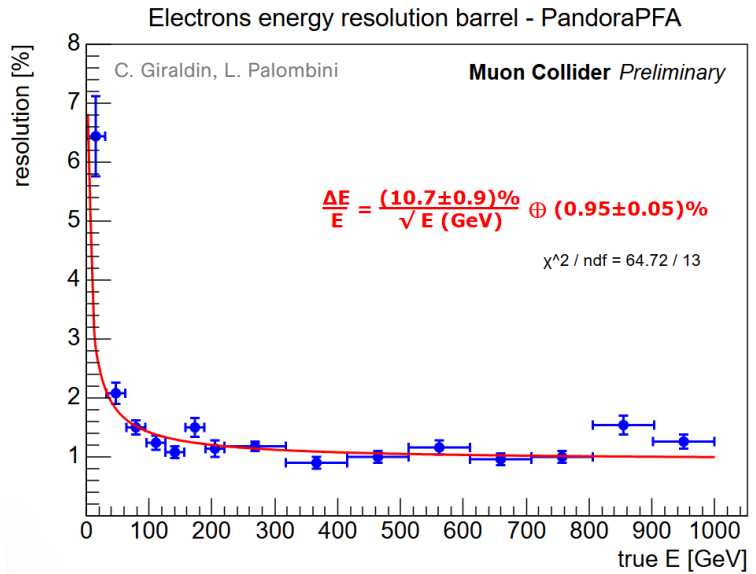



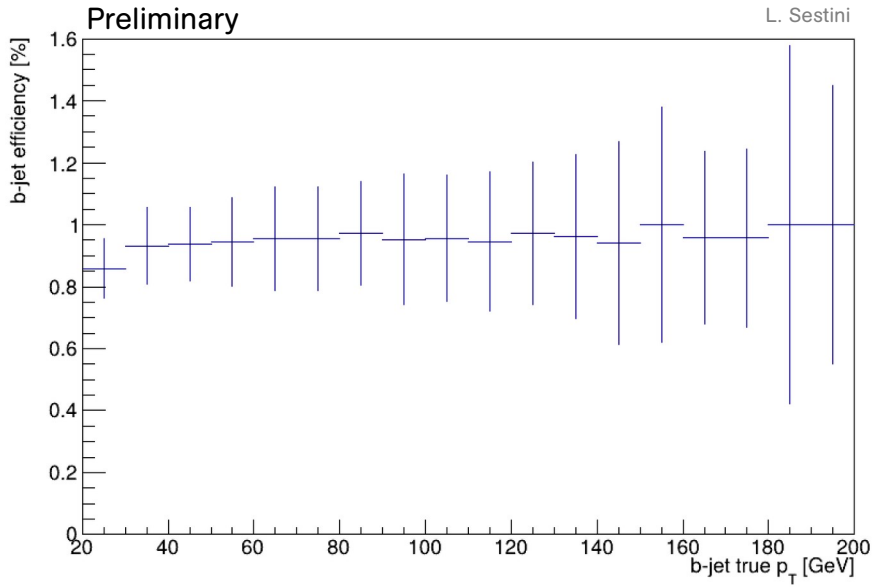
# Electron reconstruction

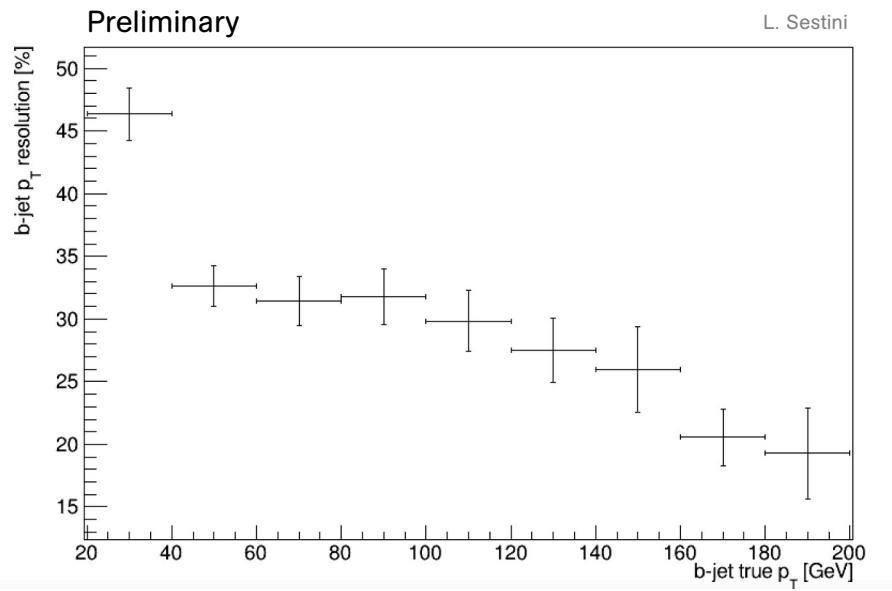


# Jet reconstruction



# Backup

# Background from muon decays

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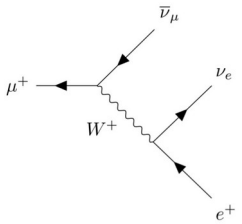


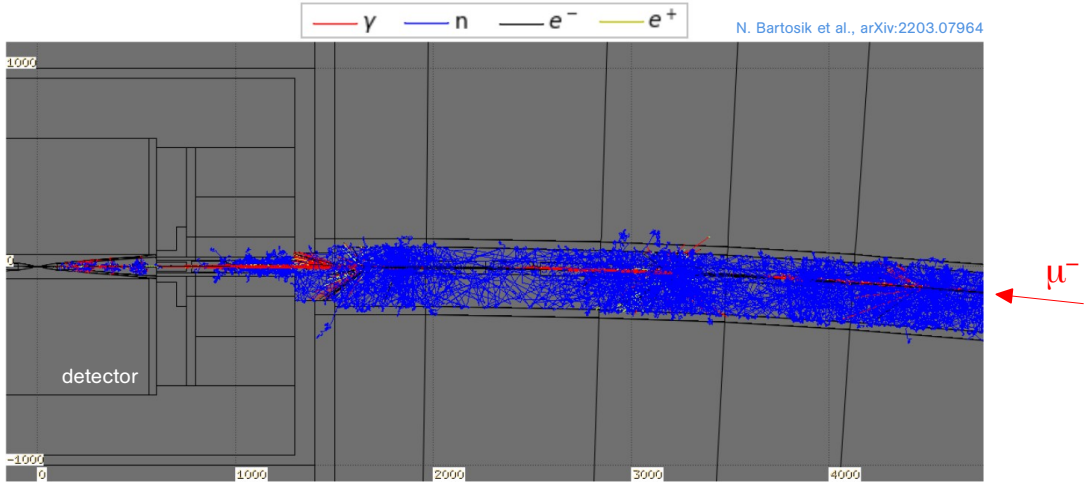


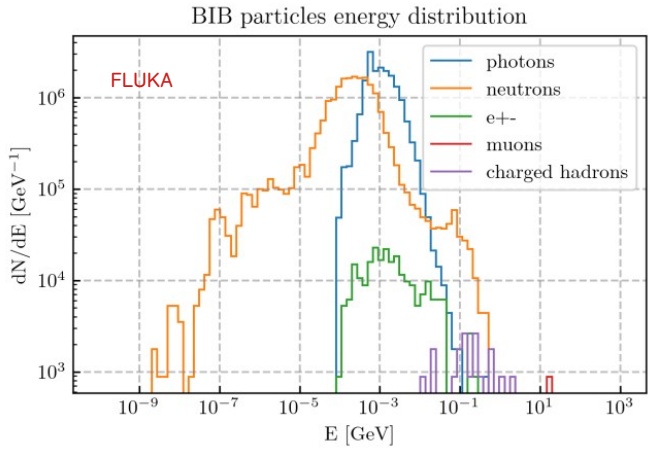


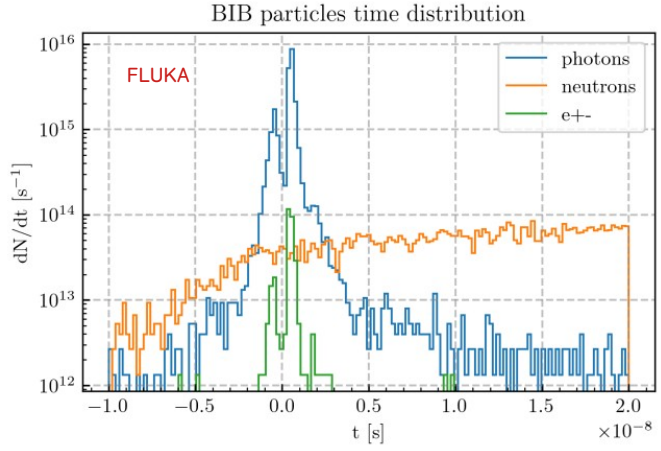


- Beam-induced background (BIB) from muon decay products interacting with the machine components and the shields inside the detector (nozzles):
  - soft particles and mostly out of time w.r.t. the bunch crossing:
  - $\sim 10^8$ photons, $\sim 10^7$ neutrons, and $\sim 10^5$ electrons/positrons enter the detector at every bunch crossing in the time window [-1, 15] ns.
- Extensively studied with MARS15 and FLUKA.

# Bkg from incoherent $e^+e^-$ pair production

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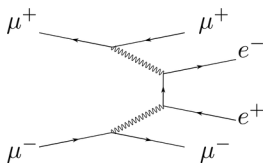


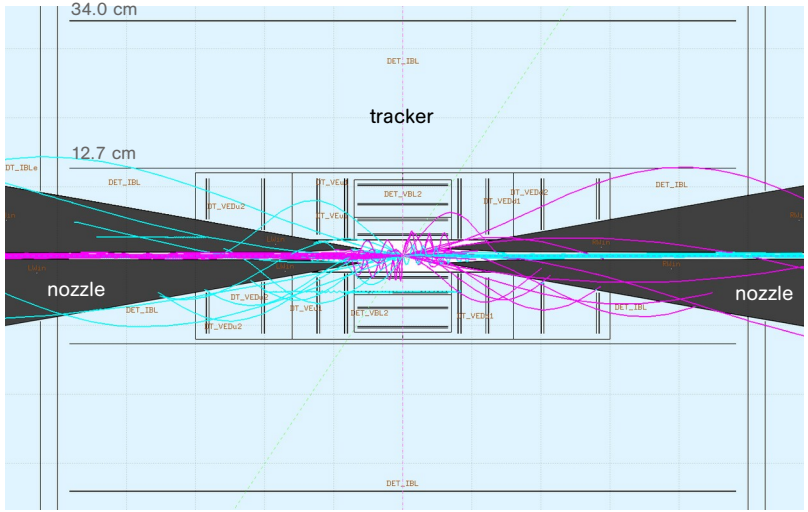


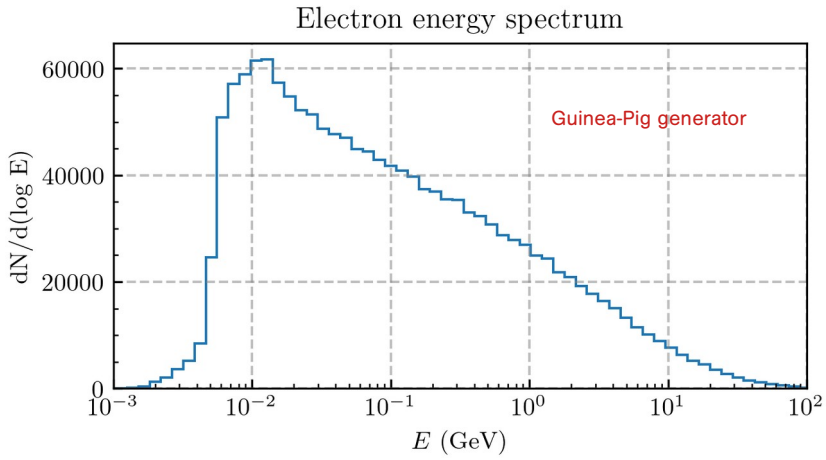


- Background from incoherent $e^+e^-$ pairs produced at bunch crossing:
  - relatively high-energy $e^{\pm}$, which enter the detector at the interaction point in time with the bunch crossing;
  - photons ($\sim 10^6$), neutrons ($\sim 10^5$), and electrons/positrons ($\sim 10^5$);
  - affects mainly the vertex detector and the inner tracker layers.
- The solenoidal B field helps in confining most of the $e^{\pm}$ in the innermost region close to the beampipe.