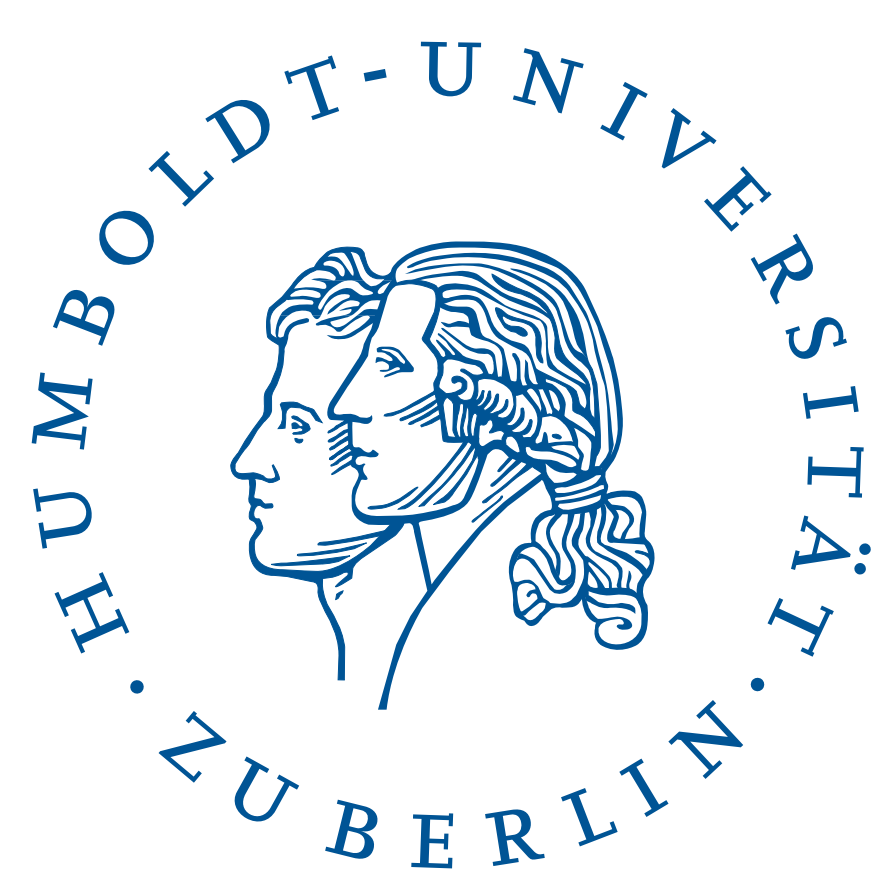


Tracking at a muon collider



Hanns Jörg Weber (Humboldt-Universität zu Berlin, presenter) and

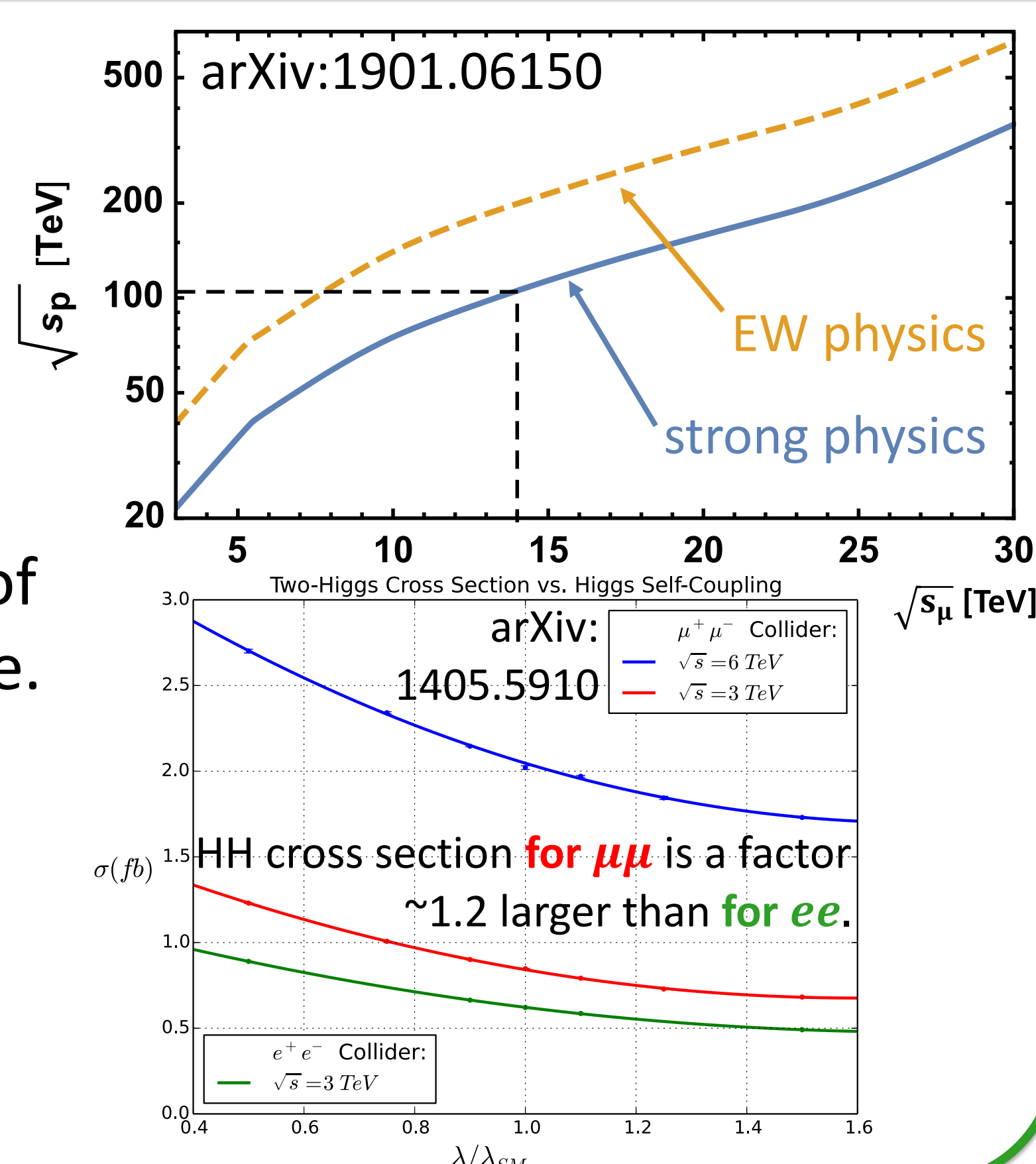
David Yu (Brown U), Federico Meloni (DESY), Sergo Jindariani (FNAL), Lawrence Lee (Harvard U), Paolo Andreetto, Laura Buonincontri, Alessio Gianelle, Donatella Lucchesi, Lorenzo Sestini (INFN Padua/U Padua), Massimo Casarsa, Alessandro Montella (INFN Trieste/U Trieste), Nazar Bartosik, Nadia Pastrone (INFN Torino), Karol Krizka, Simone Pagan Griso, Elodie Resseguie (LBNL), Philip Chang (UCSD)

on behalf of the Muon Collider Physics and detector working group

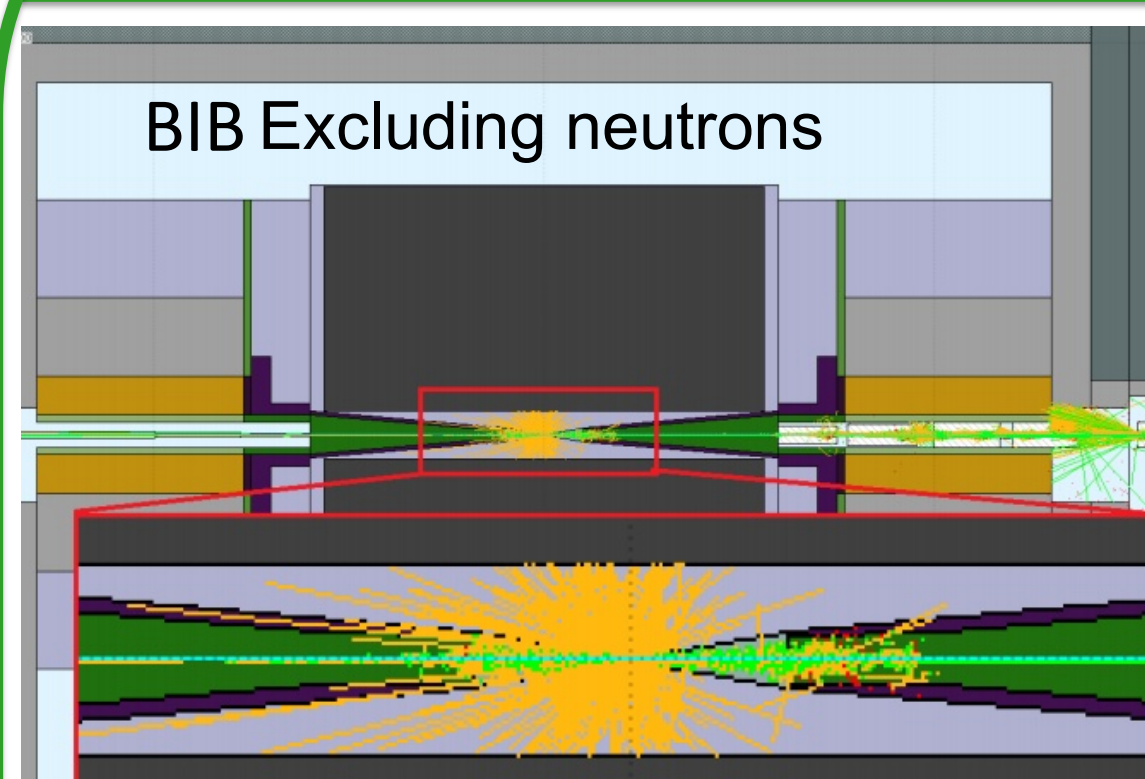
Why a muon collider?

A muon collider can reach high $\sqrt{s}$ due to low bremsstrahlung.

Physics reach of a multi-TeV $\mu\mu$ collider could surpass those of a 100 TeV pp machine.



Challenge to a muon collider experiment

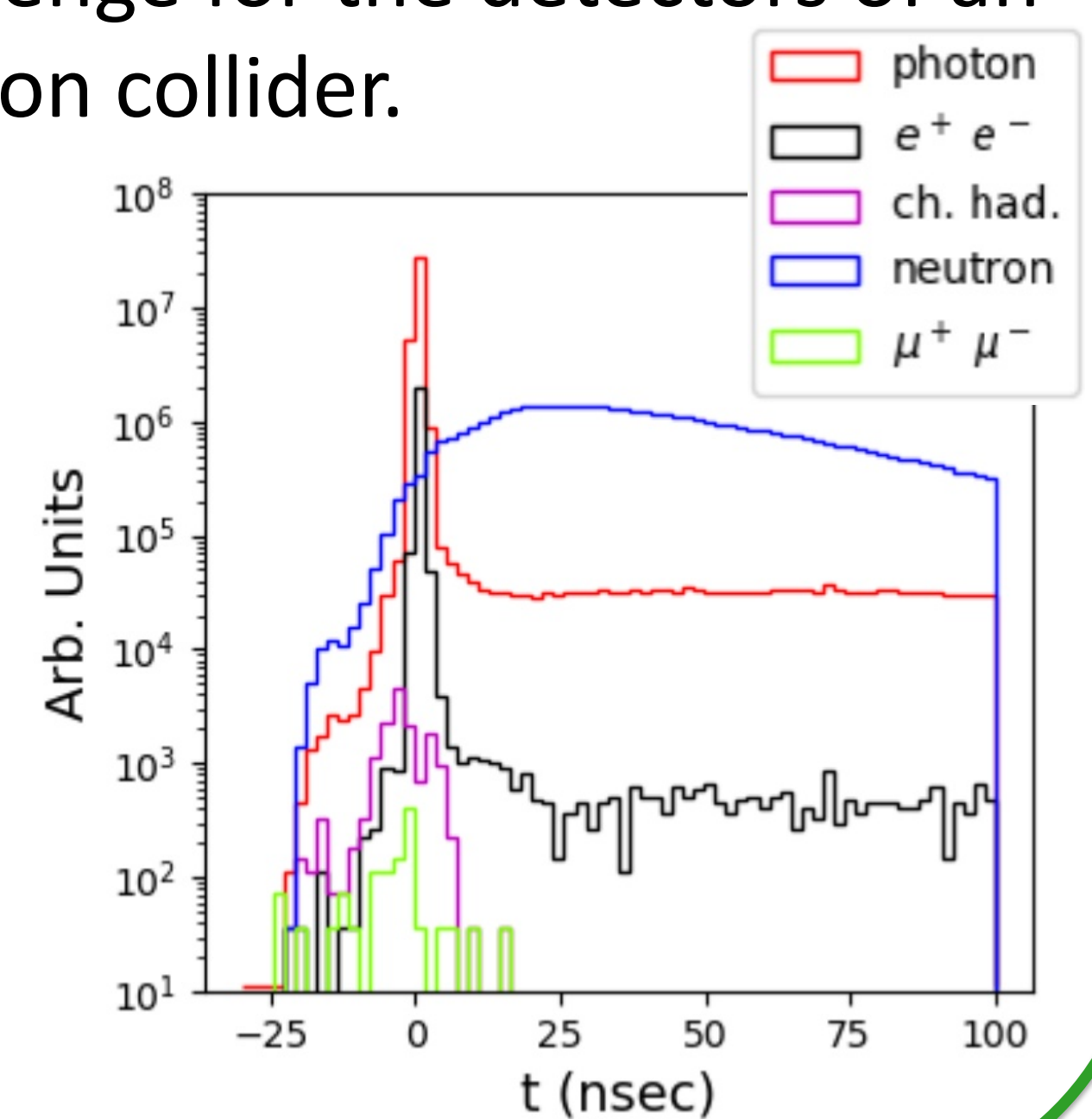


Muons are unstable and decay in flight.

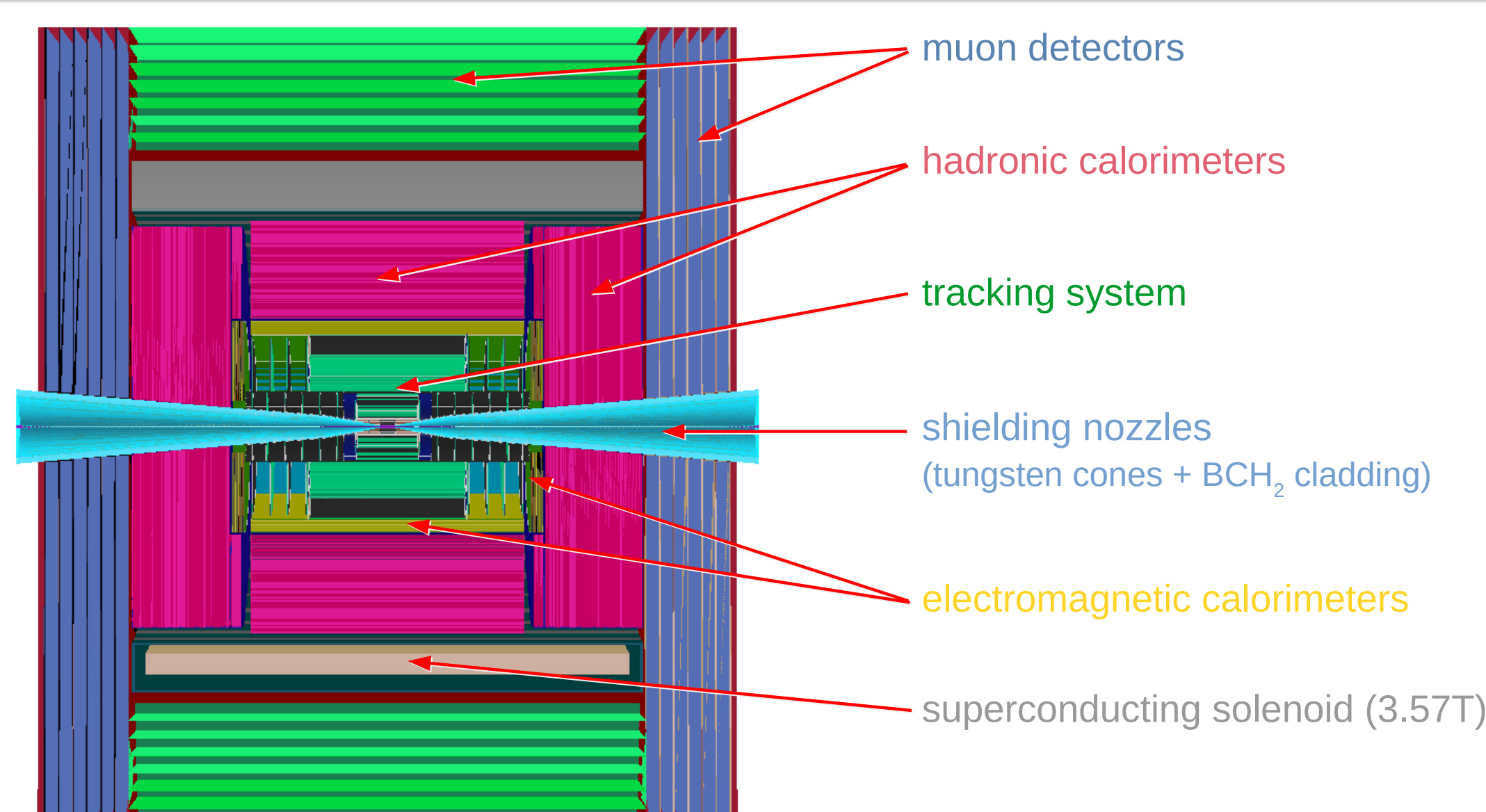
The muon beam induced background (BIB) creates a huge challenge for the detectors of an experiment at a muon collider.

The detector is bombarded by $O(100)$ million (mostly soft) particles (mostly photons and neutrons) per beam crossing out of which $O(1)$ million are charged.

The challenge for the tracker is to be able to reconstruct particle trajectories in that environment.



A Muon collider experiment

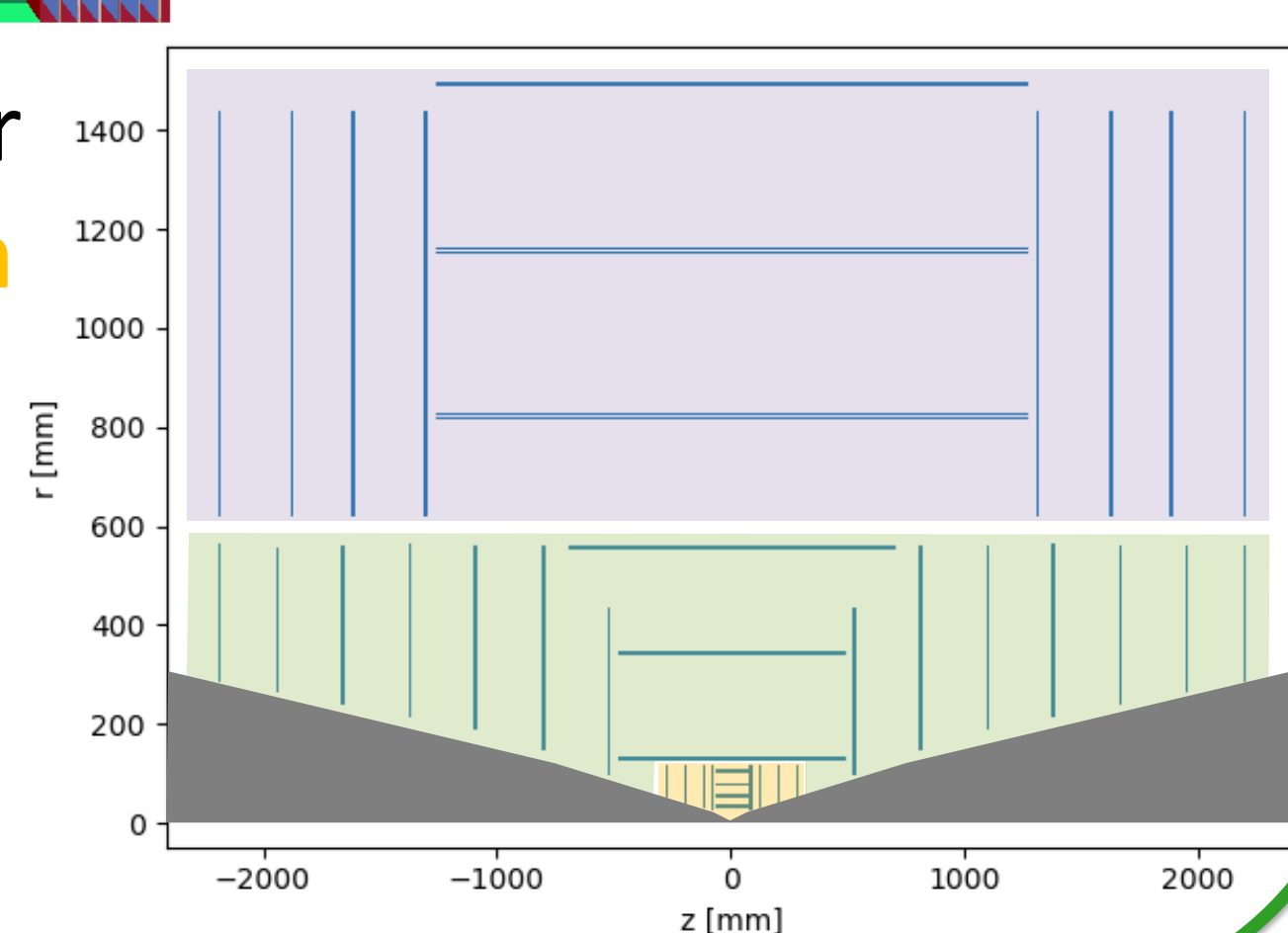


Silicon-based tracker

Vertex detector with double-sensored layers

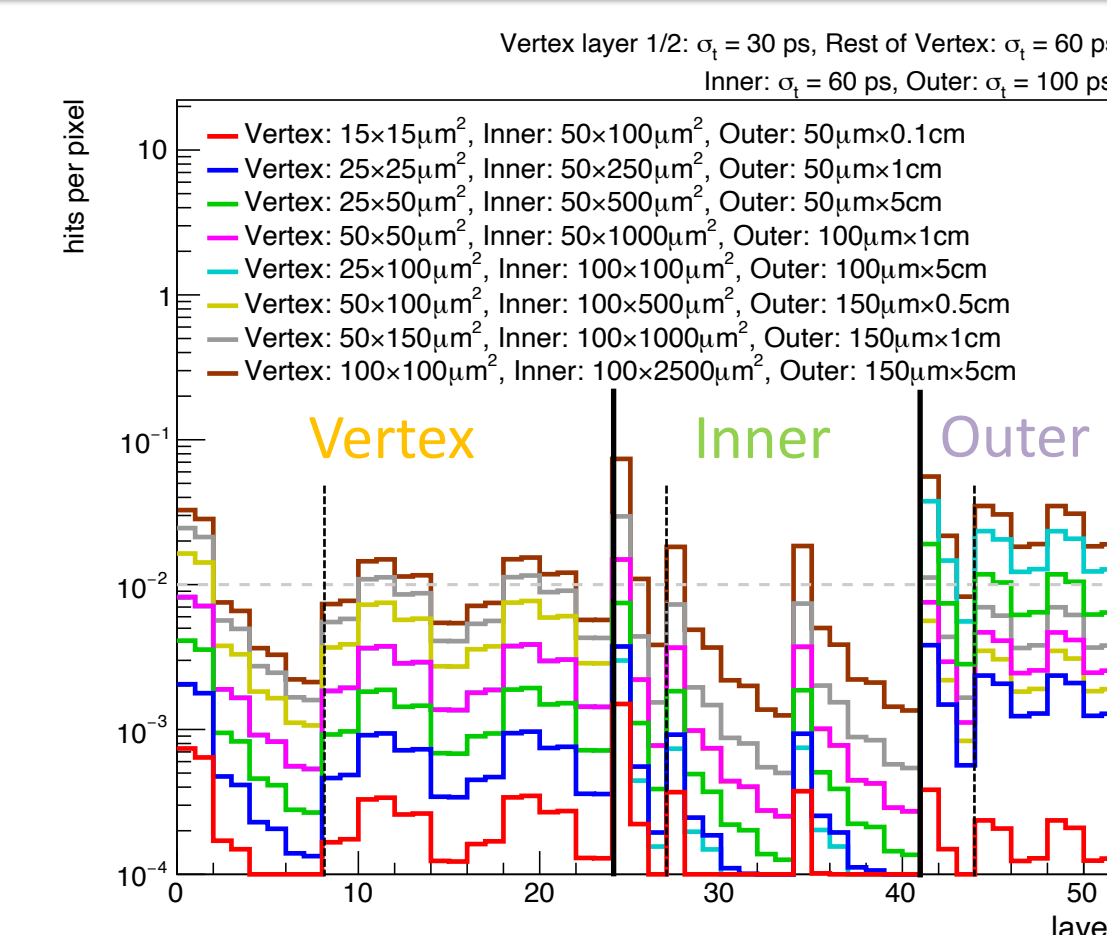
Inner tracker

Outer tracker

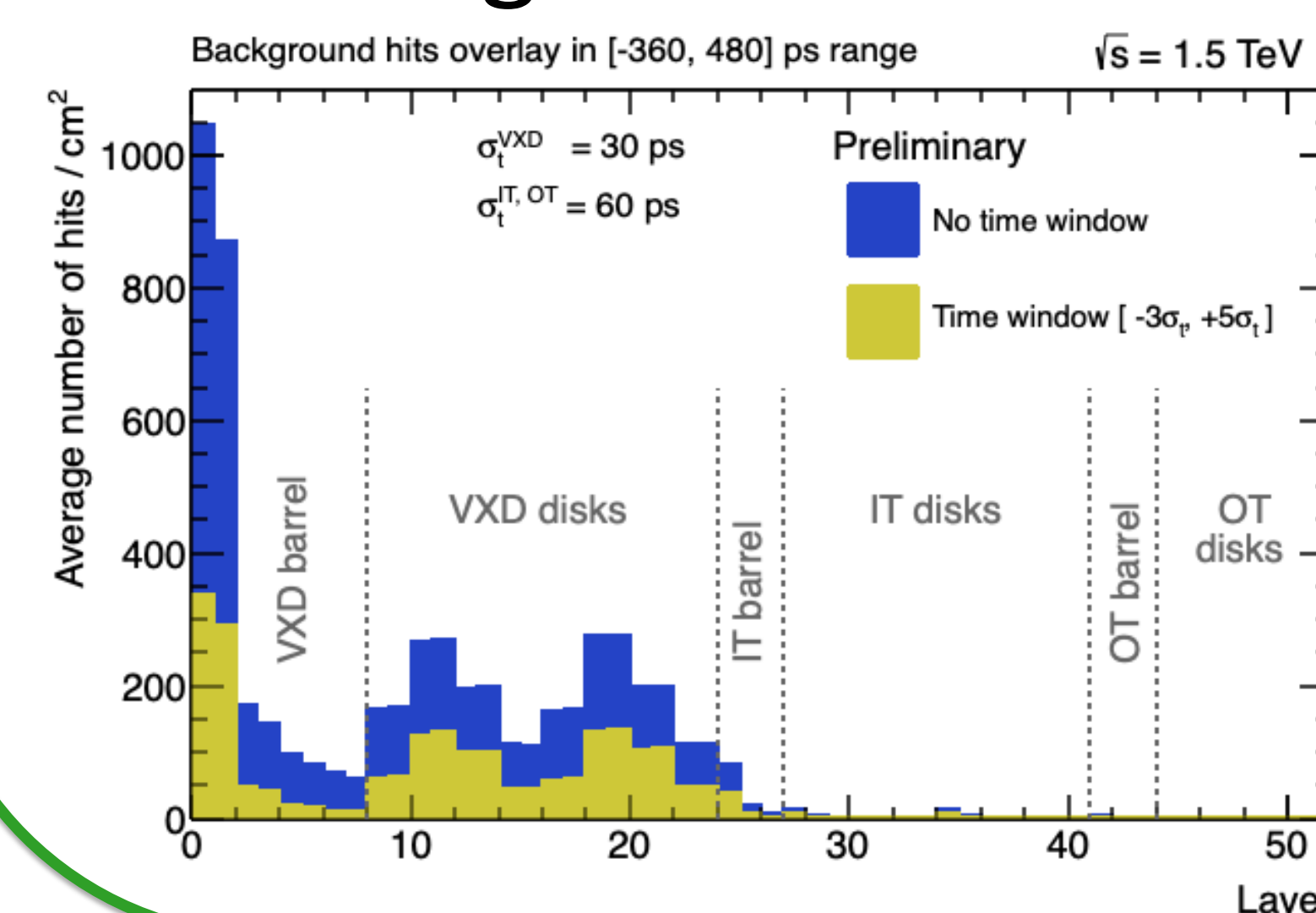


Tracker requirements and BIB mitigation

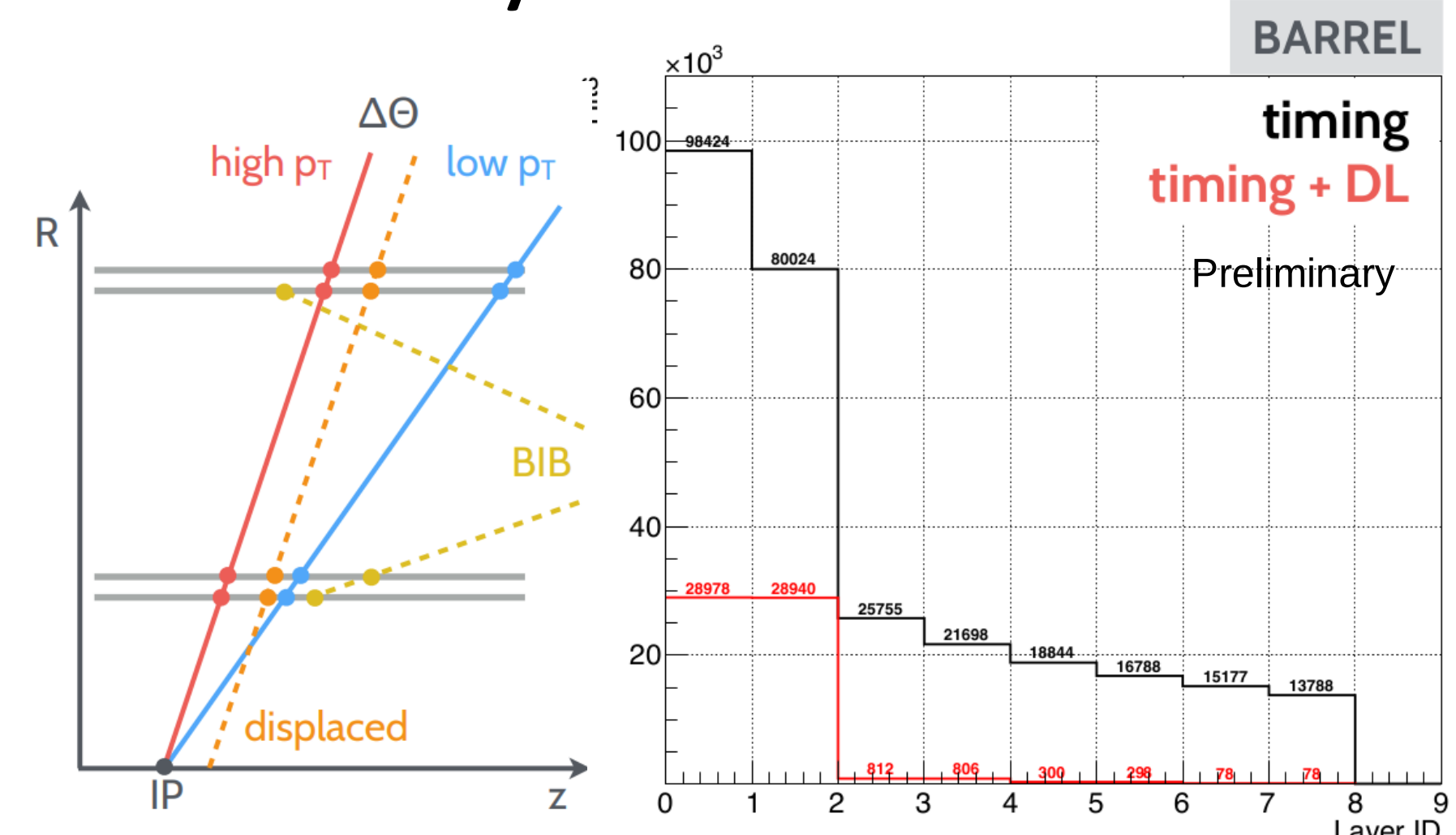
Small pixels:



Fast timing:



Double layer structure:



Other handles:

Cluster shape $\rightarrow$ E. Resseguie

In-chip data reduction

Faster readout links: potentially factor 2-5 needed with respect to HL-LHC

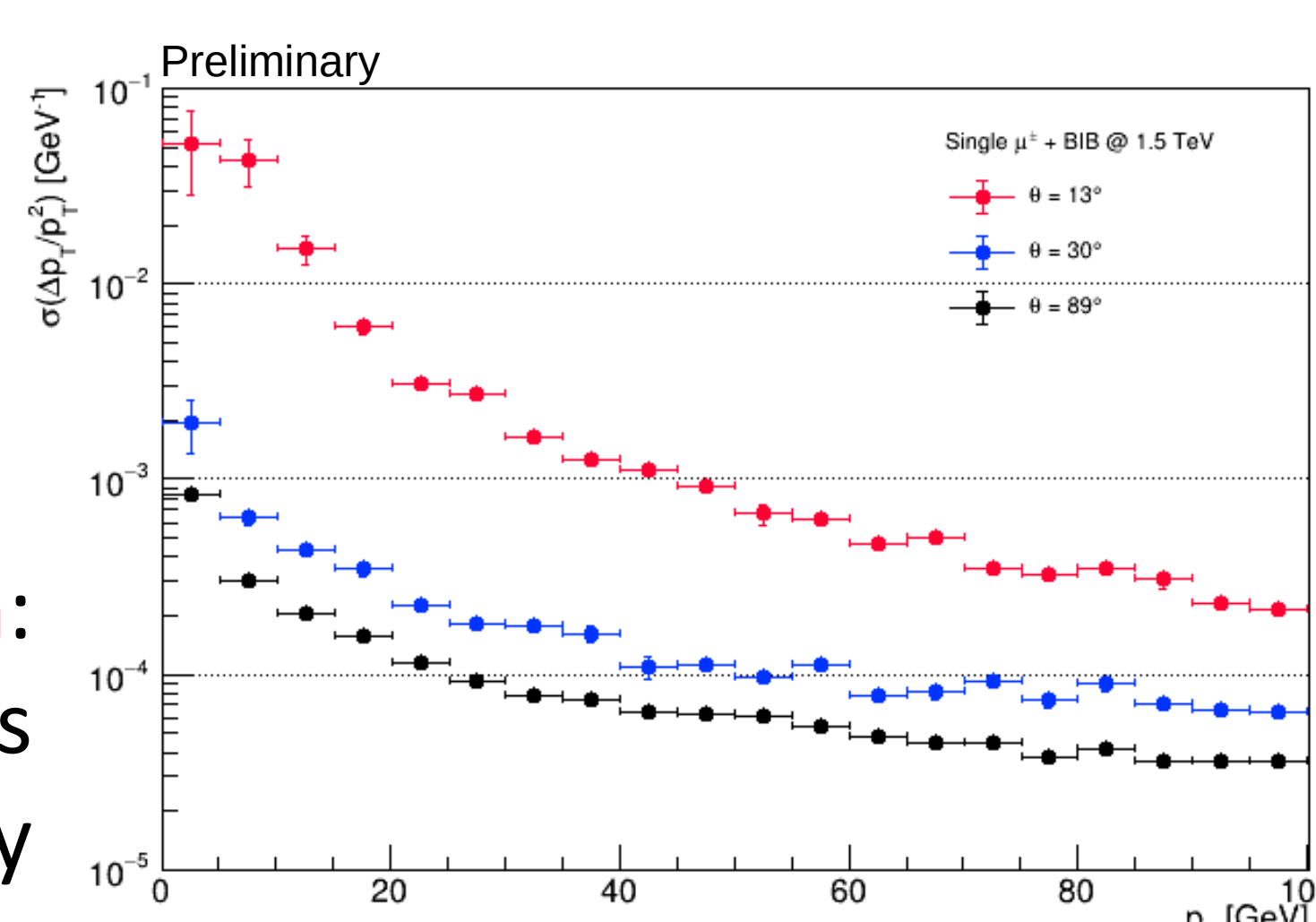
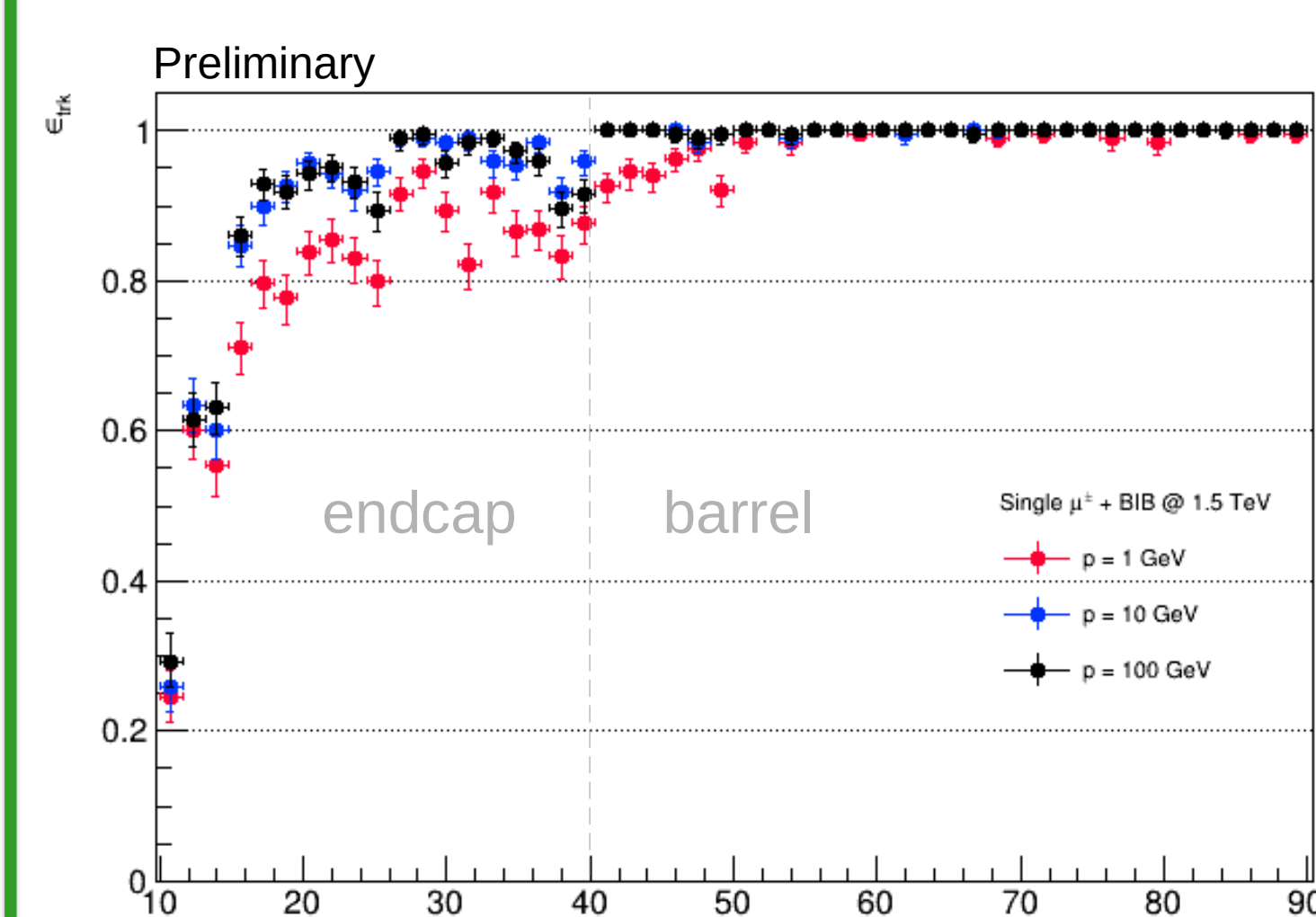
Track reconstruction

Hard **combinatorics problem** due to high number of BIB particles. Current tracking algorithm heavily uses CLIC studies:

- Conformal tracking and cellular automaton for track finding
- Other ideas based on ACTS being explored ($\rightarrow$ K. Krizka)

Tracking efficiency: very good in central region, poorer close to nozzle.

Tracking resolution: corresponding effects compared to efficiency



Summary

- Challenge for tracking at a muon collider is the high number of BIB particles.
 - Need high granularity, fast timing, intelligent readout, directional information
 - But these requirements are feasible. Also more handles being investigated
- Track reconstruction well understood:
 - Good tracking efficiencies and resolution except close to the shielding nozzles and very soft tracks.
 - Further ideas (e.g. to improve reconstruction time) are being explored.