Pixel TPC simulations in the ilcsoft ILD framework

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Nikhef lepcol gridpix meeting

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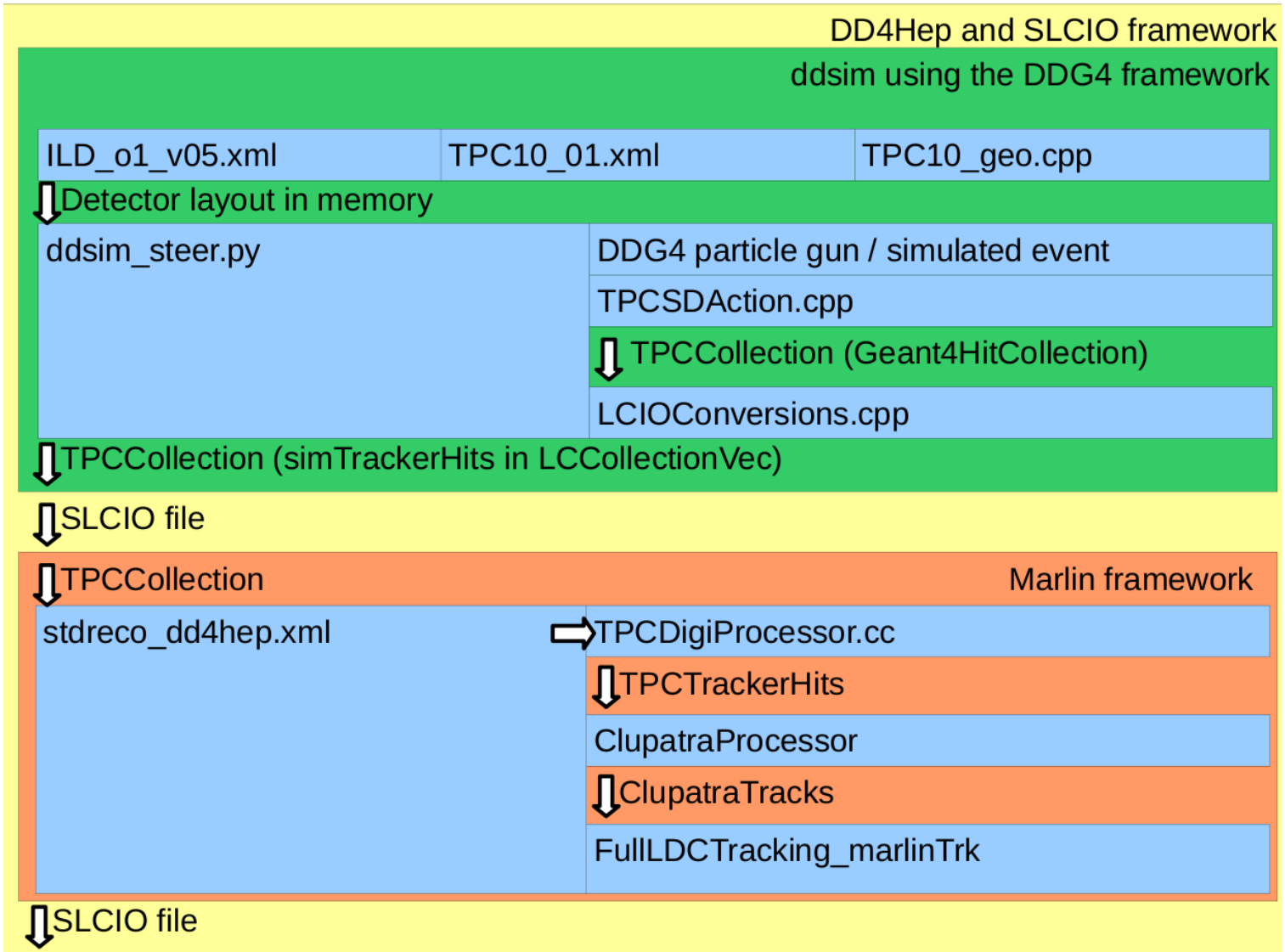
Outline

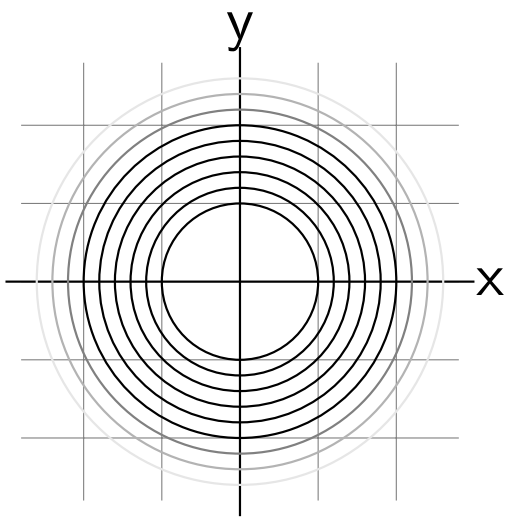
Overview of the ilcsoft framework for the TPC

- Ilcsoft is the collection of software for the ILC/ILD
- Simulation in geant4 using the DD4HEP detector description tool
- Reconstruction using processors in the modular Marlin framework
  - Marlin processors should also use DD4HEP, but the TPC processors still use the deprecated GEAR
- Ilcsoft installed on lepcol project space at Nikhef
  - found at `/project/lepcol/ilcsoft/`
  - setup environment with
    `source /project/lepcol/ilcsoft/v01-17-10/init_ilcsoft.sh`

Overview of the ilcsoft framework for the TPC



Simulation of pads



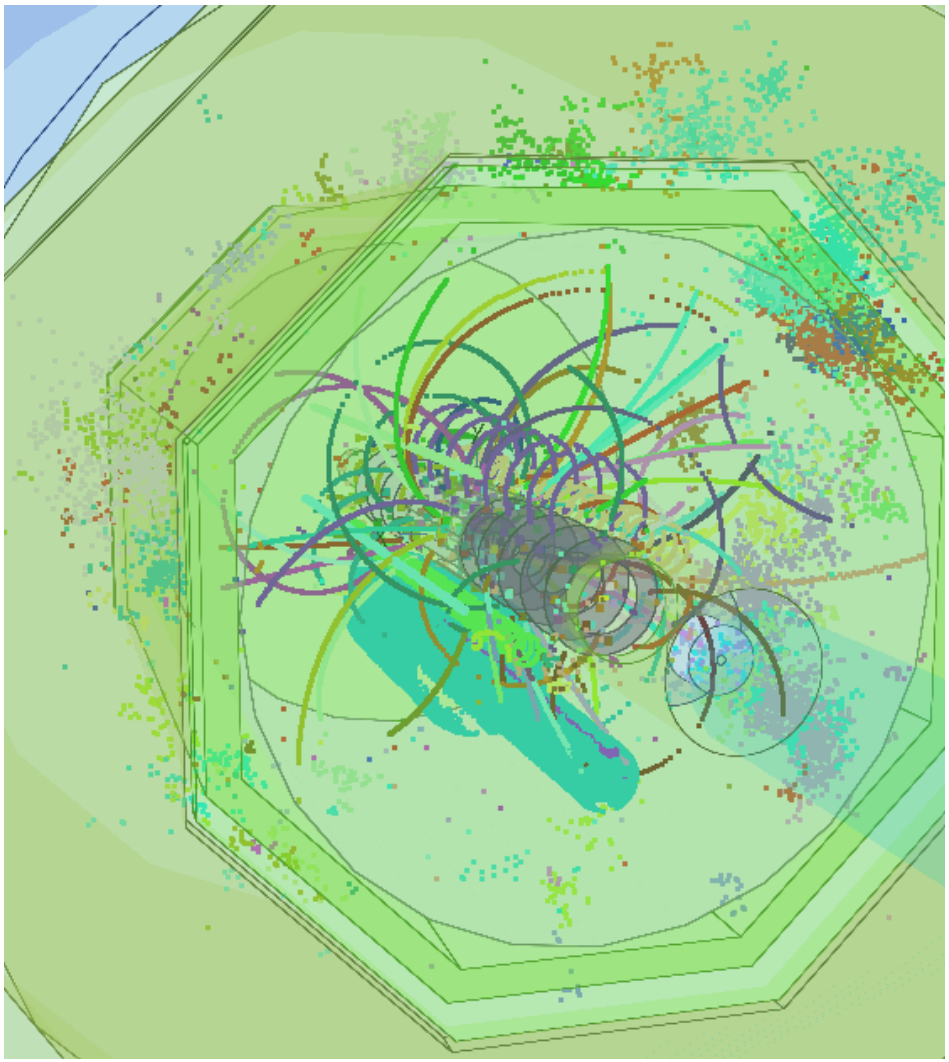
Volumes are organised as tube shaped layers, there are no pad columns

1. Detector described by DD4HEP geometry is loaded. Sensitve gas volumes are made
2. Geant4 processes interactions of particle(s) from gun or event
3. Single hit in TPC is deposited if energy above threshold (32eV) in a single pad. Position of pad centre crossing is recorded
4. TPC hits are smeared by expected resolution in TPCDigiProcessor. Hits can migrate to other pads
5. Smeared hits are used as input for reconstruction

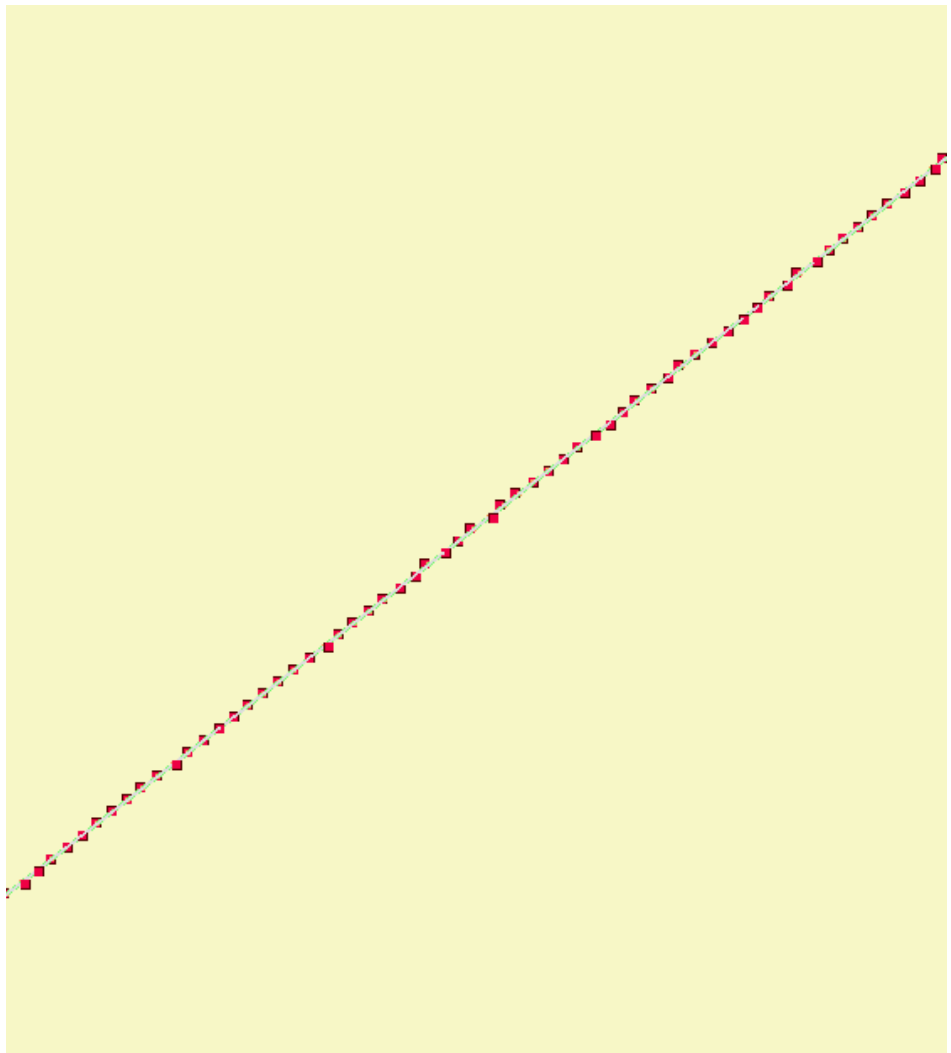
Simulation of pixels

- Simulate pixels as small pads
  - Shrink pad size from 6×1 mm to 0.055×0.055 mm
  - Allow multiple deposits per pixel crossing before smearing
  - Requires replacement of the the GEAR geometry by the DD4hep geometry

Pad event display and muon track display

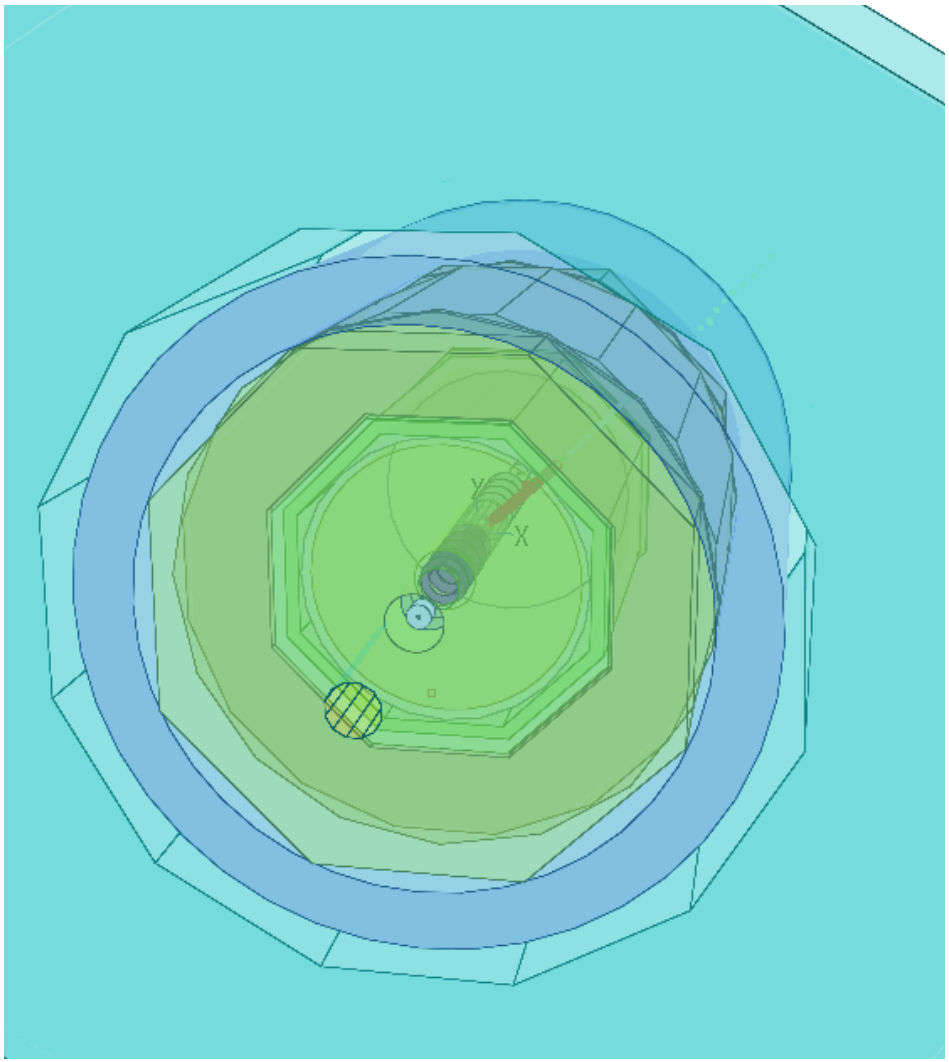


$t\bar{t}$ event display



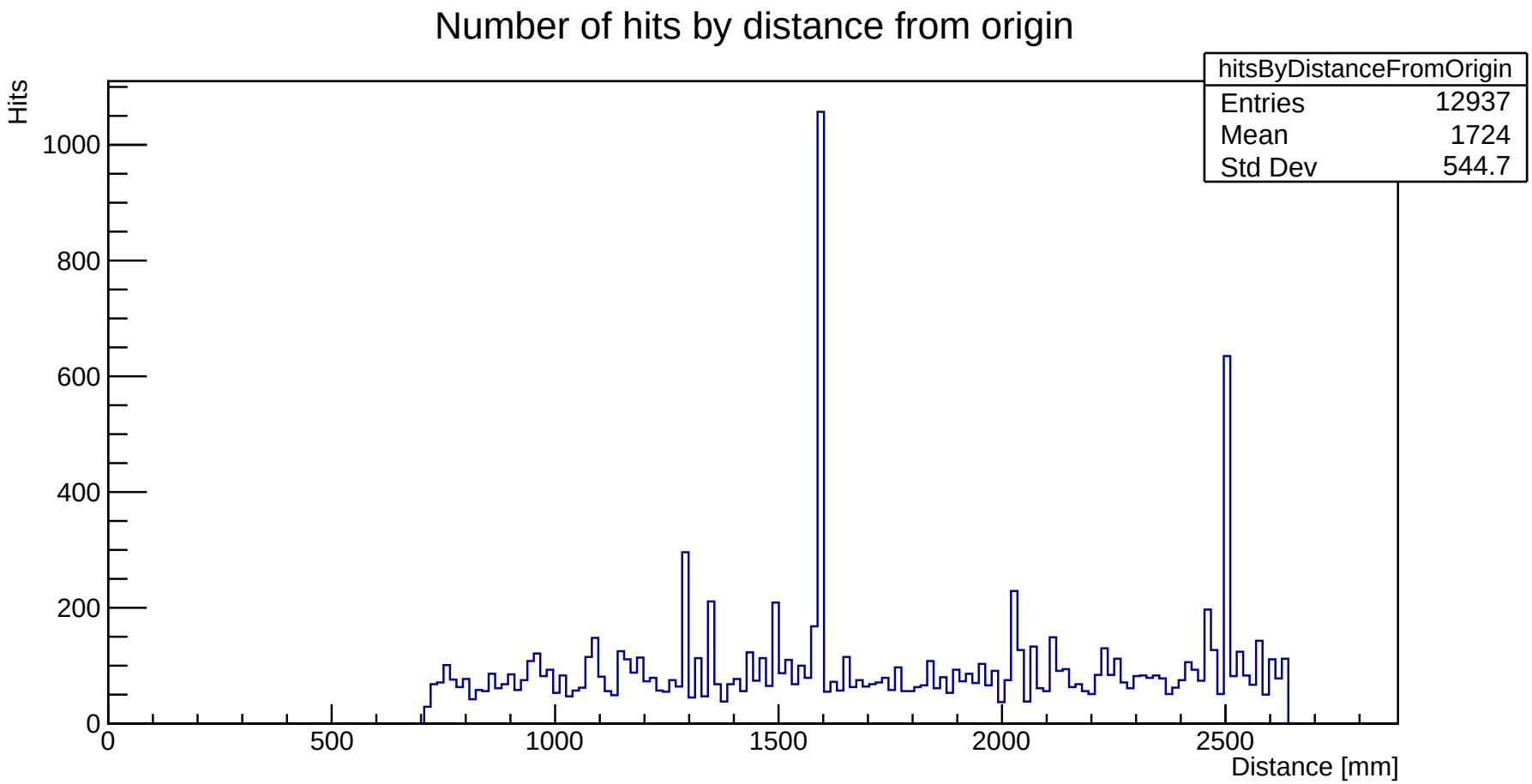
single 50 GeV μ^- track

Pixel muon track display



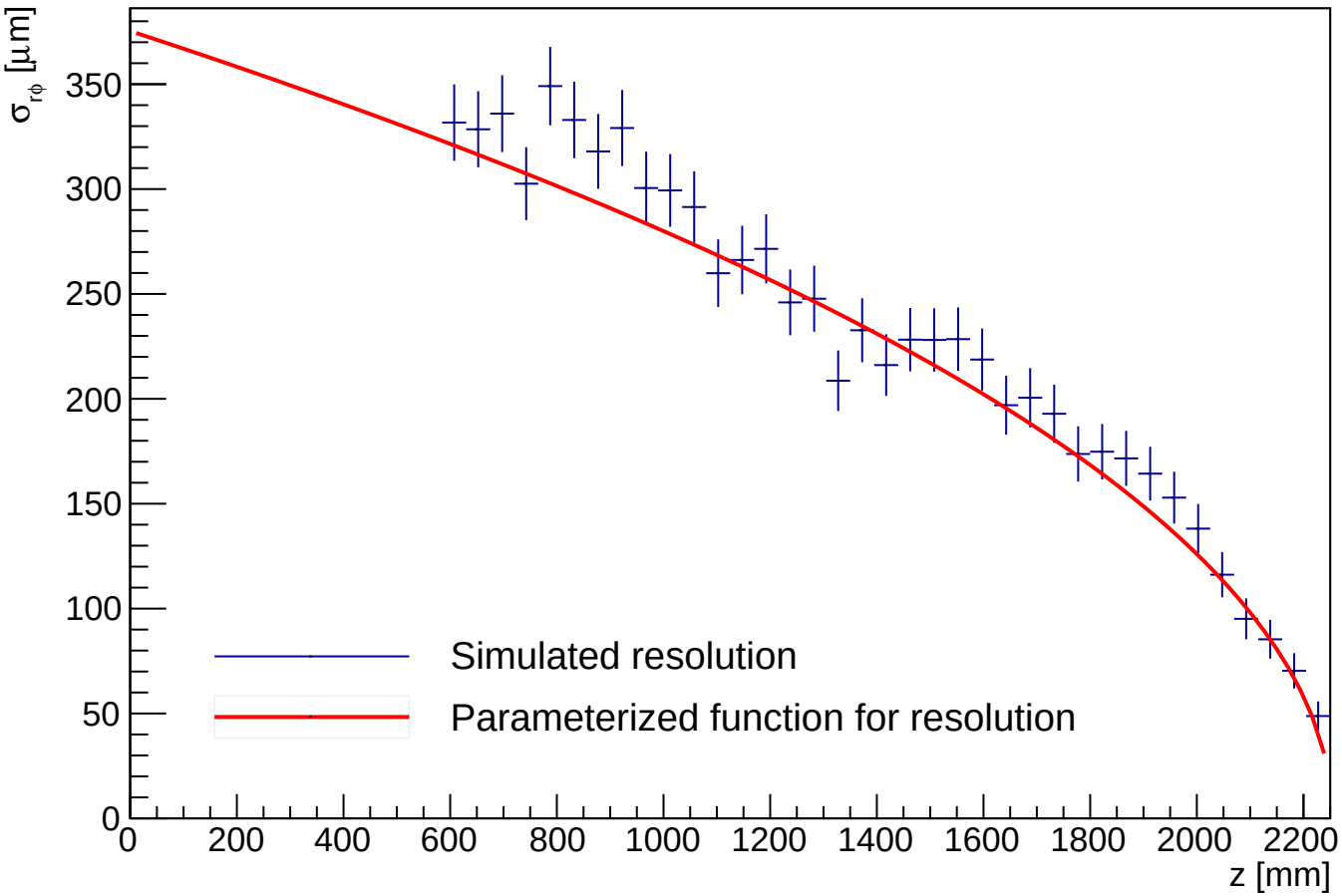
single 50 GeV μ^- track

Hits along track



More than 10 000 hits for a 50 GeV muon track for pixels, compared to 170 for pads

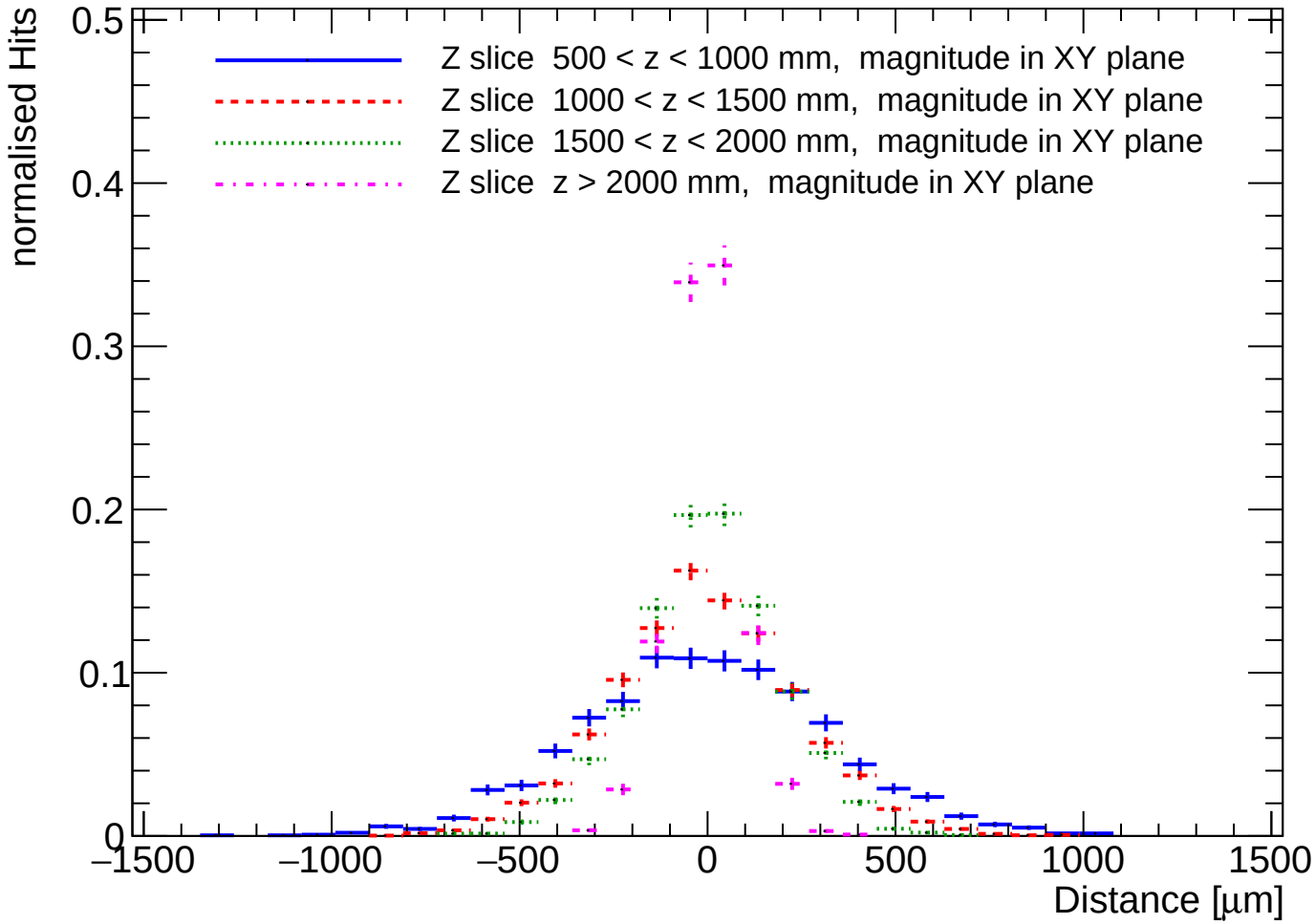
Resolution as function of drift length



Resolution is better closer to the endplate, at larger z

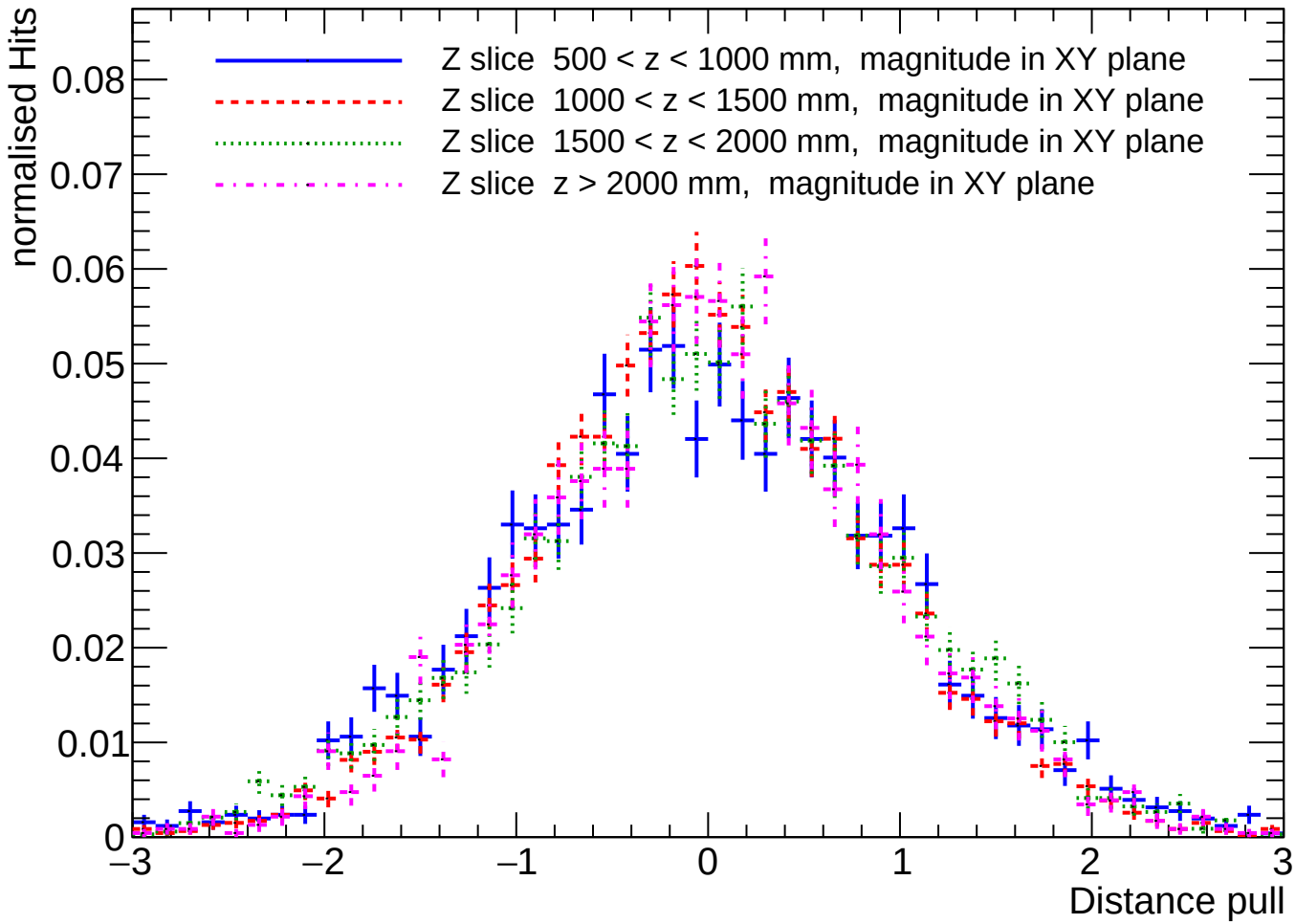
- Simulated resolution is standard deviations of distance to track
- Function is smearing magnitude

Orthogonal distance in z slices



Resolution for different z

Pull diagrams of drift distance in z slices



Pull is gaussian

Conclusion

- The Ilcsoft framework is installed
- Pixel sized pad simulation works for particle gun tracks

- Next steps:
  - Change pixel TPC hit deposit action. Currently simulation takes hours for $t\bar{t}$ event
  - Look into reconstruction of tracks
  - Replace GEAR by DD4Hep for reconstruction code