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MAUS Status

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Overview

- Current Release
- Upcoming Releases
- Detectors
- Resolutions Summary
- Future plans
- Conclusion

Current Release

- Current release: MAUS-v2.1.0
- Download: `http://heplnv152.pp.rl.ac.uk/maus/`
- Highlights:
  - Tracker geometry bugs (nearly) all fixed
  - Tracker straight fits optimised
  - EMR speed improvements
  - Global tracking in
  - Upgraded unpacker
- Known issues:
  - Beamline magnet polarity incorrect
  - Small tracker geometry bug
  - Minor bug in geometry download script
  - Global tracking bug when run on real data

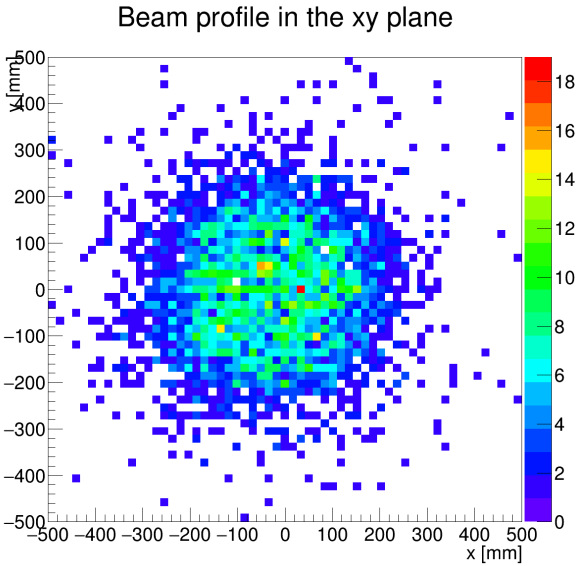
Upcoming Releases (2.2.0, 2.3.0)

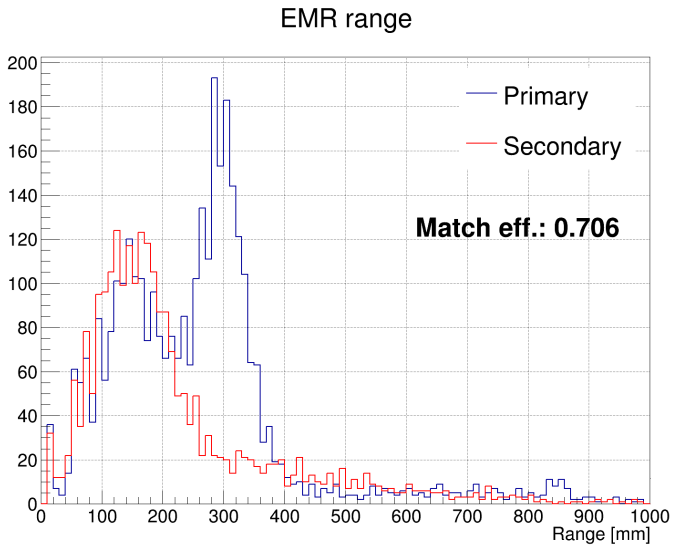
- Fix last geometry bugs
- Fix last tracker Kalman fit issues
- Improve tracker pattern recognition helical tracking efficiency
- Fix Global tracking bug
- Add Event Viewer as third party library
- New Online Reconstruction framework (C++ only)
- Upgrade to ROOT6 (latest Scientific Linux compatibility)

Detector Overview

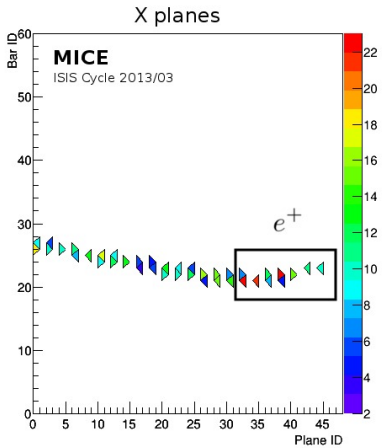
- CKOV - functional
- TOF - Done
  - Except for the trigger MC
  - See the TOF Reconstruction talk
- Tracker - Almost there
  - Optimise pattern recognition
  - Last few Kalman filter bits
  - See later slides
- KL - Done
- EMR - Done
  - Speed up in latest release
  - See the EMR talk and next slide

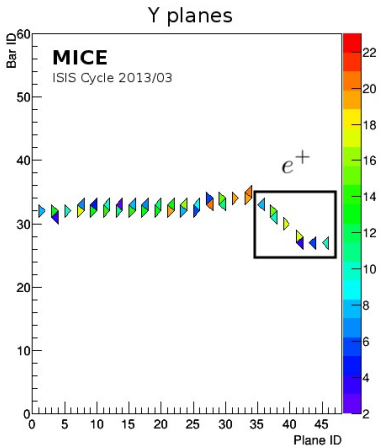
EMR





Very sharp muon peak (blue right), distinct pion peak (blue left) and clean Michel electron distribution (red)

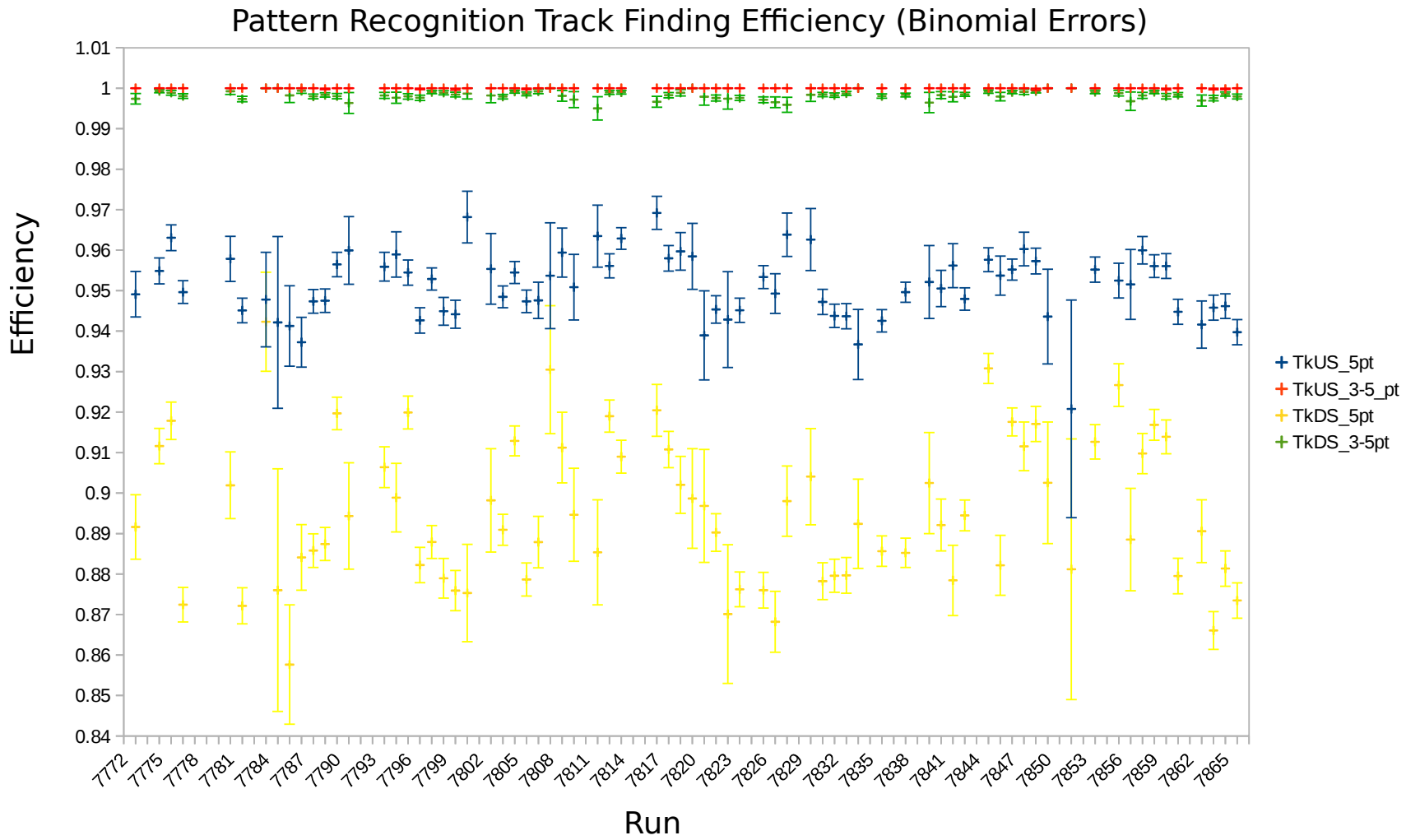




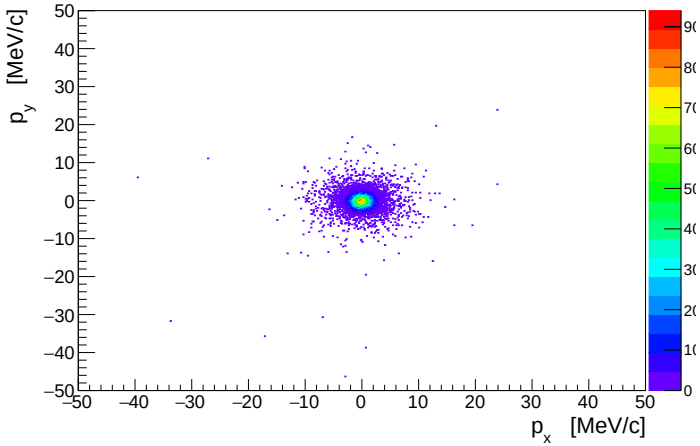
Tracker

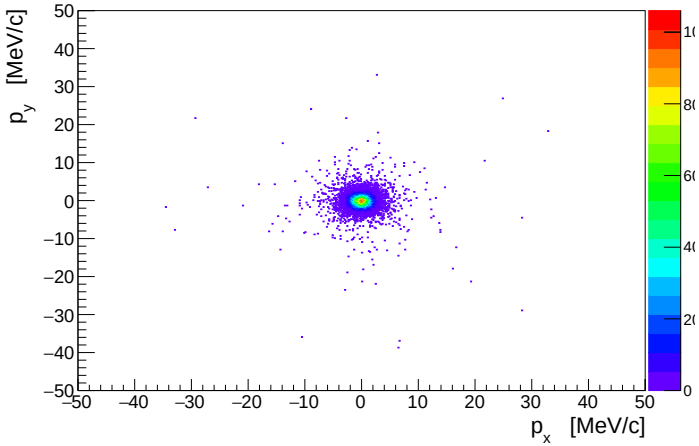
- Straight track pattern recognition now optimised using data
- Helical pattern recognition still to be optimised
  - Optimise cuts
  - Select best χ^2 fit result
  - New number of turns algorithm
- Geometry now virtually fixed
- Last few things for Kalman
- Online Reconstruction plots expanded
- Lots of performance and efficiency work done
- Paper close to being ready for arXiv, latest draft at:
  `https://github.com/mice-software/scifi-software-paper`

Pattern Recognition Efficiency (Real Data)

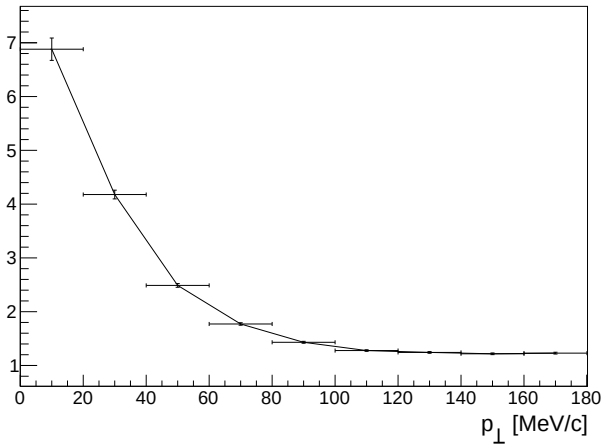


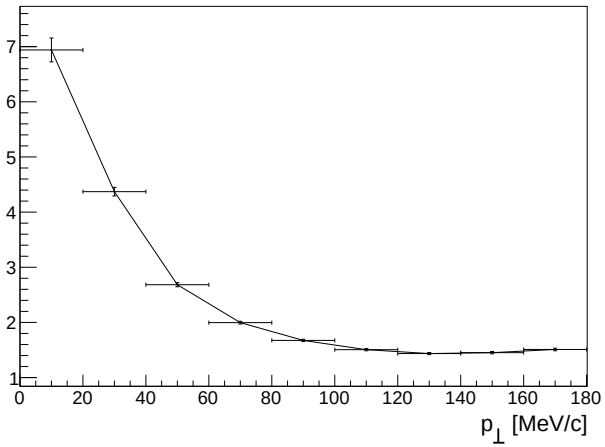
Track Fit Performance (Simulation)





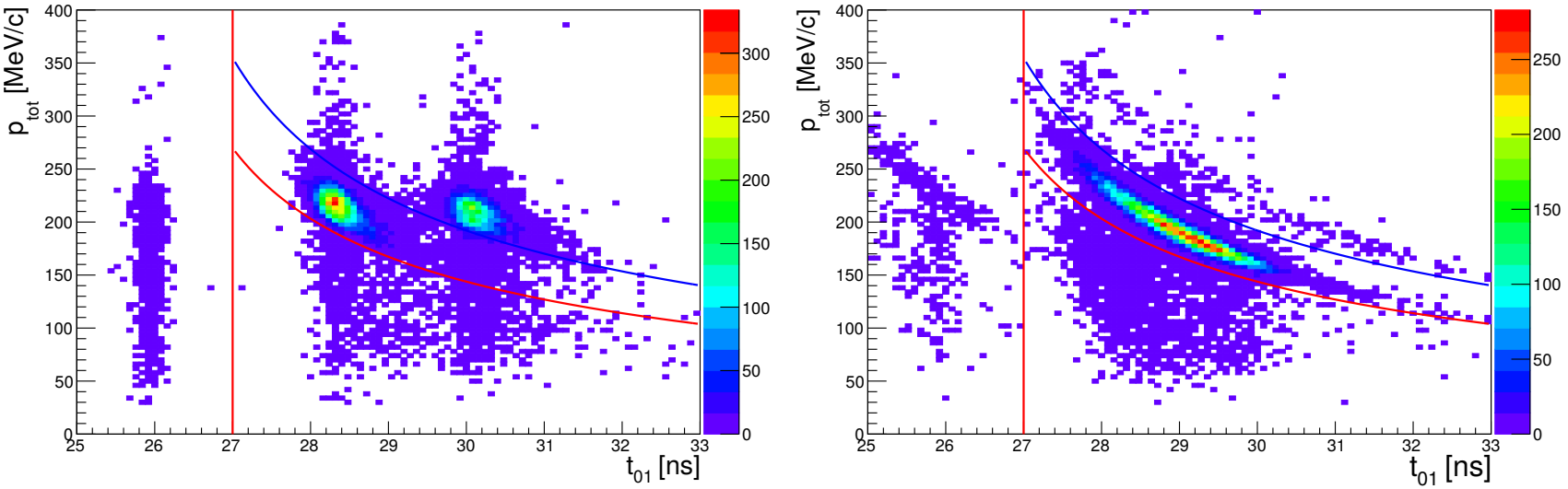
Upstream (left) and downstream (right) p_x - p_y residuals





Upstream (left) and downstream (right) p_z resolution vs. p_t

Tracker - TOF Plots



Left: Time-of-flight compared with tracker momentum for a π run, e, μ, π peaks visible.
Right: Time-of-flight compared with tracker momentum for a μ run, e, μ peaks visible.

Odd sholder below the peaks - suspects are scraping or reconstruction error

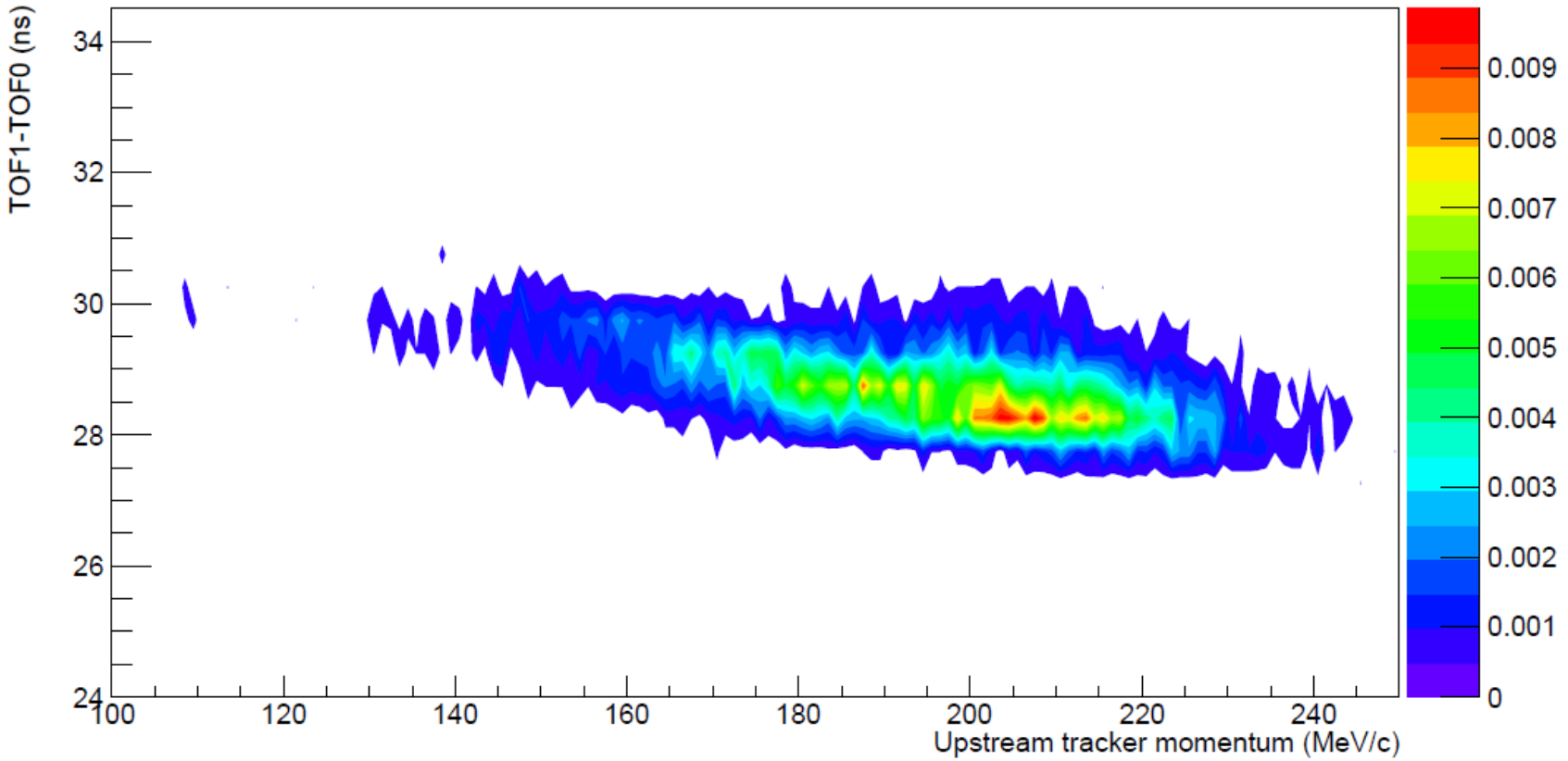
Global Reconstruction

- Combines output of all detectors to provide best PID hypothesis and track fit
- 3 parts: track matching, track fit, PID
- Track Matching: Determine which detector hits belong to the same track and combine them so that PID (and later analysis) can be run on them
- Track Fitting: Improve the matched trackpoints using information from all detectors as well as provide the possibility of extrapolation to uninstrumented sections of the beamline
  - Will probably use Kalman Filter
- PID: form various variables to compute PID, e.g. time of flight vs tracker momentum (see next slides)
- First working code set in release 2.1.0
- ... but a bug in track matching when running over real data, fix ready (MC works)

Global Reconstruction: PID

- PID framework, variables, and example scripts for using PID in MAUS
- Collection of PID variables, for Step IV and commissioning, now exists, using all detectors
- PID performed using GlobalPID.py in bin/Global
- Example datacard: pid_example_datacard.py
- PDF production performed using pid_pdf_generator.py in bin/Global
- Example datacard: pdf_example_datacard.py

PID Example


TOF1-TOF0 (ns)
34
32
30
28
26
24
100
120
140
160
180
200
220
240
Upstream tracker momentum (MeV/c)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0

Resolutions

Detector	Resolution
TOF0 time (measured)	52.2 ± 0.9 ps
TOF1 time (measured)	59.5 ± 0.7 ps
TOF2 time (measured)	52.7 ± 1.1 ps
TKU x-position (simulated)	0.310 mm
TKU y-position (simulated)	0.314 mm
TKU x-momentum (simulated)	1.065 MeV/c
TKU y-momentum (simulated)	1.216 MeV/c
TKU z-momentum (simulated)	4.117 MeV/c
TKD x-position (simulated)	0.310 mm
TKD y-position (simulated)	0.314 mm
TKD x-momentum (simulated)	1.036 MeV/c
TKD y-momentum (simulated)	1.248 MeV/c
TKD z-momentum (simulated)	3.845 MeV/c

Tracker data shows MC estimates, as not enough helical data taken yet (from MICE Note 451).

Future Plans

- Event viewer into online reconstruction
- Speed up MC
- Simulate the trigger
- Multithread option
- 'Live' onrec view, rather than png files
- Update documentation
- Expand integration tests
- Git version control?

Conclusion

- MAUS is providing reconstructed data, simulatation and real, to collaborators for all the MICE detectors
- MAUS is providing live online data reconstruction and visualisation for shifters
- Some optimisations and fixes remain, notably in the final stages of the tracker reconstruction and the global reconstruction