

Low Momentum Track Reconstruction Efficiency

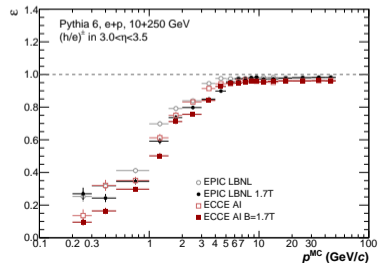
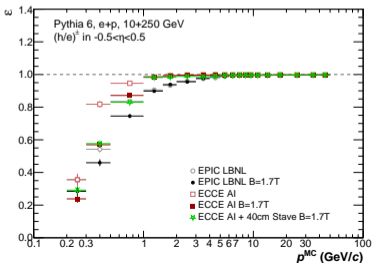
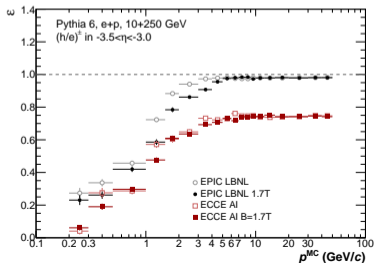
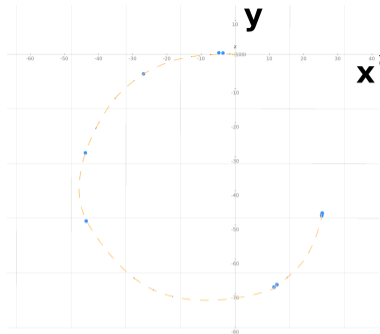
- a solution -

EPIC Tracking Meeting
August 25, 2022

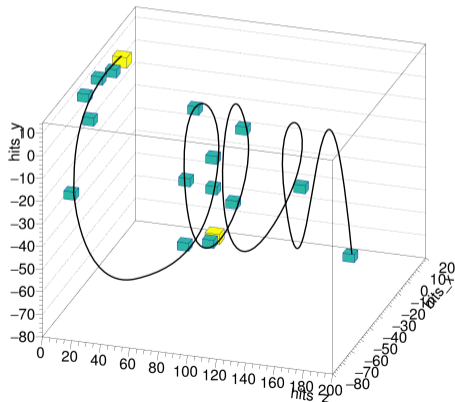
Nicolas Schmidt

Issue description

- Overall low track finding efficiency ($\epsilon = \frac{\# \text{ MC part gen. with rec. track}}{\# \text{ MC part gen.}}$) for low momentum particles in all regions (bwd, central, fwd)
- Clearly visible tracks (as visualized top right) not reconstructed
- Detector geometry and hits in detectors excluded as problem
→ sufficient hits for track reconstruction available for effectively all particles



- Switched from `m_FitAlgoName("DafRef")` to `m_FitAlgoName("KalmanFitter")` in `PHG4TrackFastSim.cc`
- "DafRef" fitter used since beginning
 - theoretically a good choice for full noise and background simulations
 - initial setup optimized for high momentum tracks (more straight tracks)
 - HOWEVER! produces ill conditioned covariance matrices for low momentum tracks
 - low momentum track fitting does not converge and tracks are discarded
- More basic KalmanFitter works great at any momentum
 - except for strongly curling tracks with high numbers of hits due to the curling

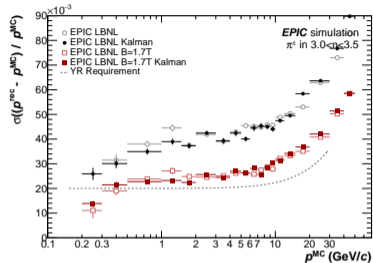
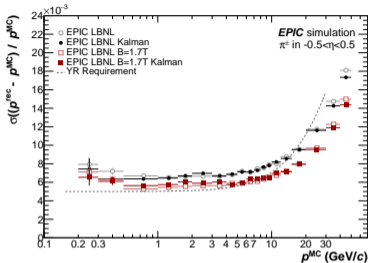
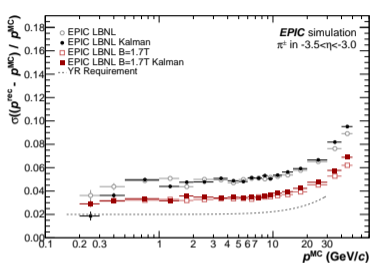


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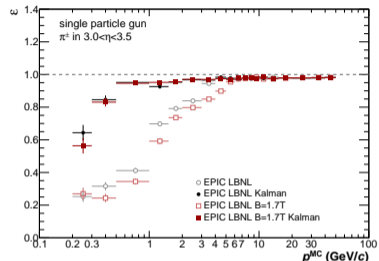
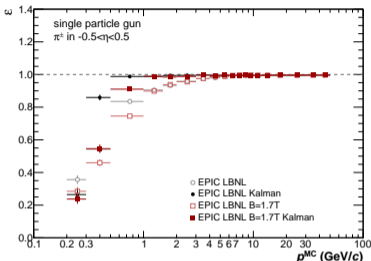
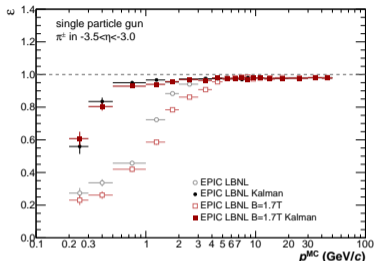
/** @brief Deterministic Annealing Filter (DAF) implementation.
 *
 * @author Christian Hoesl,ppner (Technische Universitaet Muenchen, original author)
 * @author Karl Bicker (Technische Universitaet Muenchen)
 *
 * The DAF is an iterative Kalman filter with annealing. It is capable of
 * fitting tracks which are contaminated with noise hits. The algorithm is
 * taken from the references R. Fruhwirth & A. Strandlie, Computer Physics
 * Communications 128 (1999) 197-214 and CERN thesis: Dissertation by Matthias
 * Winkler.
 *
 * The weights which were assigned to the hits by the DAF are accessible in the MeasurementOnPlane objects
 * in the KalmanFilterInfo objects.
 */

```

Issue solution - Momentum Resolution



KalmanFitter results in similar (or slightly better) momentum resolution compared to DafRef



- Significant improvement in tracking efficiency with KalmanFitter (marked as “Kalman” in plots)
- Remaining low momentum due to curling tracks where Kalman fails
→ could be improved by further constrains in fitter, but would be a difficult region in real data as well

Conclusions and Outlook

- Current track fitter breaks down for low momentum particles
→ recovered by switch to different fitter
- Efficiency greatly improved with same momentum resolution
→ very good efficiency now also in TOF momentum region
- Studies of vertex/sagitta layer optimizations to be re-checked
- Further Kalman optimizations possible (but maybe not needed in Fun4All anymore)