VXD Hit Recovery for Belle 2

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B2 Tracking Meeting
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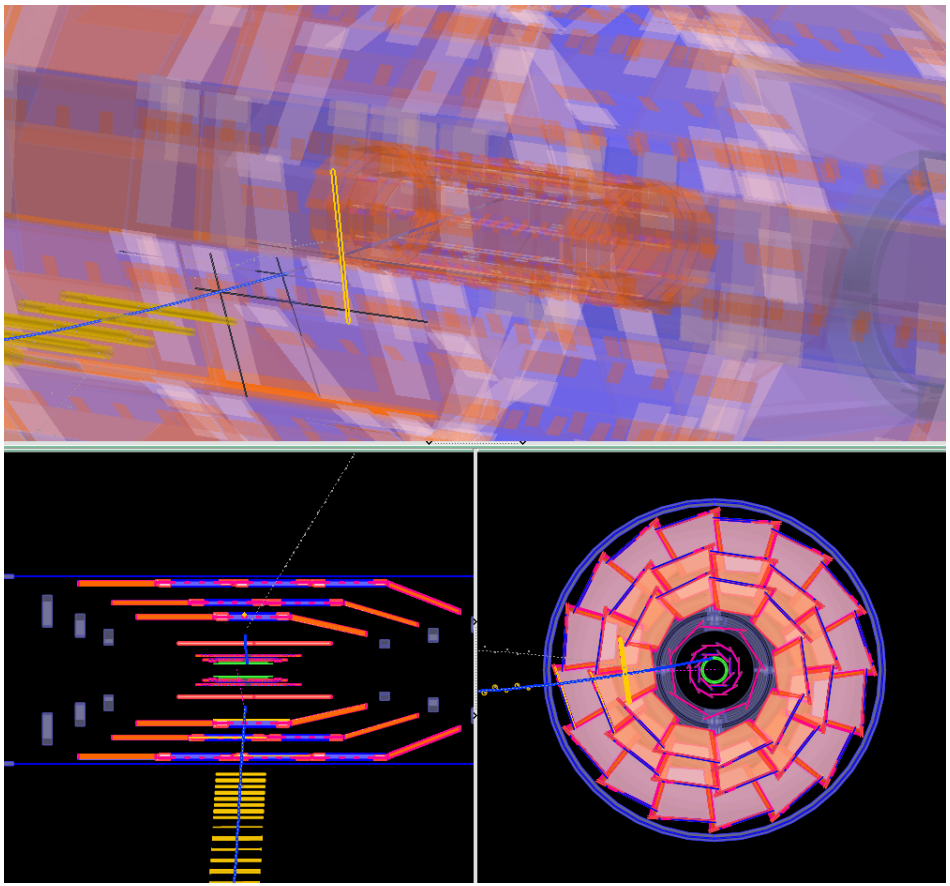
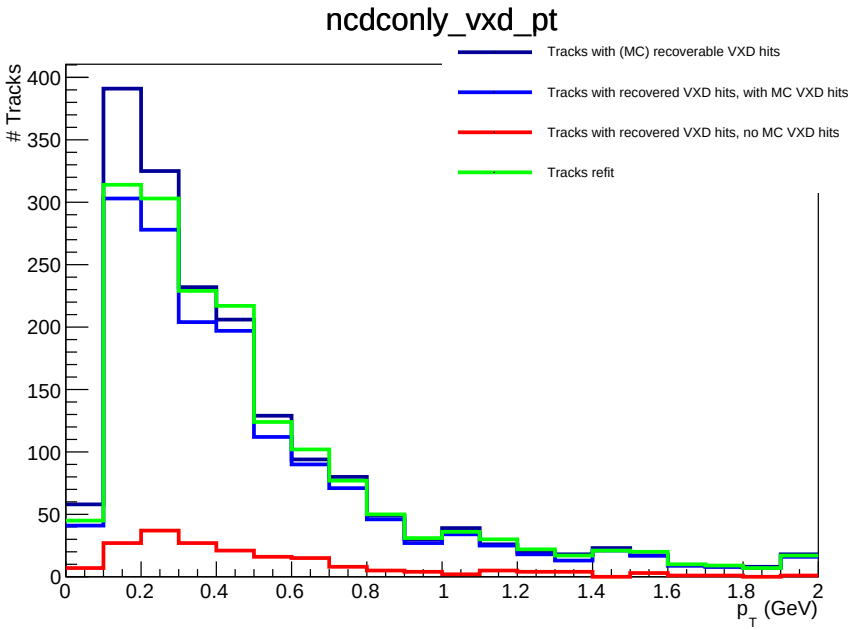
(Reminder) Project Goals

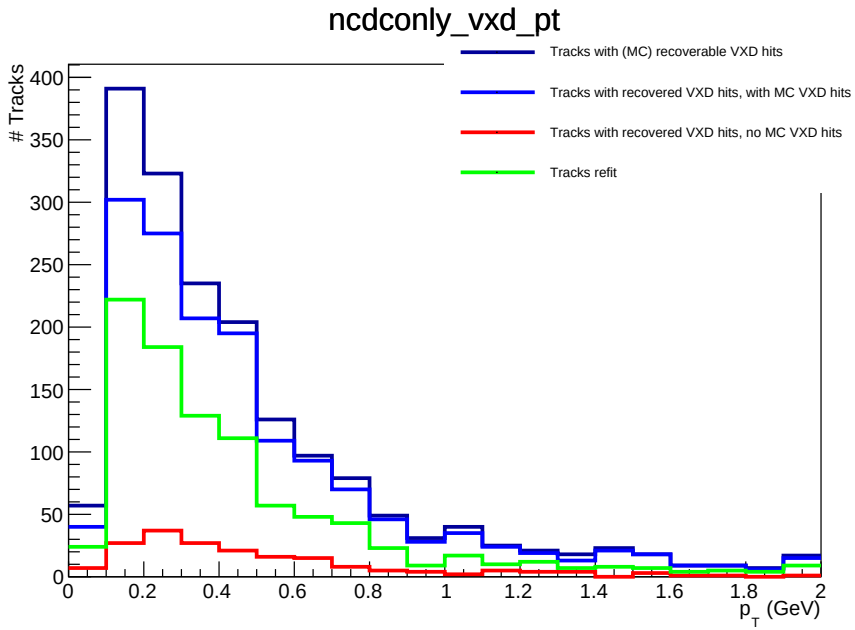


Example: pion from K_S decays between layer 3 & 4, not found by VXD track finder

- Current tracking requires particle can be found stand-alone in VXD for VXD hits to be used
- But, e.g., K_S can decay inside VXD, leaving some VXD hits without enough to find as a standalone track
- Have created a module to take CDC-only tracks and extrapolate back into VXD, create new track adding compatible VXD hits
  - Was using difference in track extrapolation to cone/cylinder and clusters in z for v-hit assignment and d_{xy} for u-hits

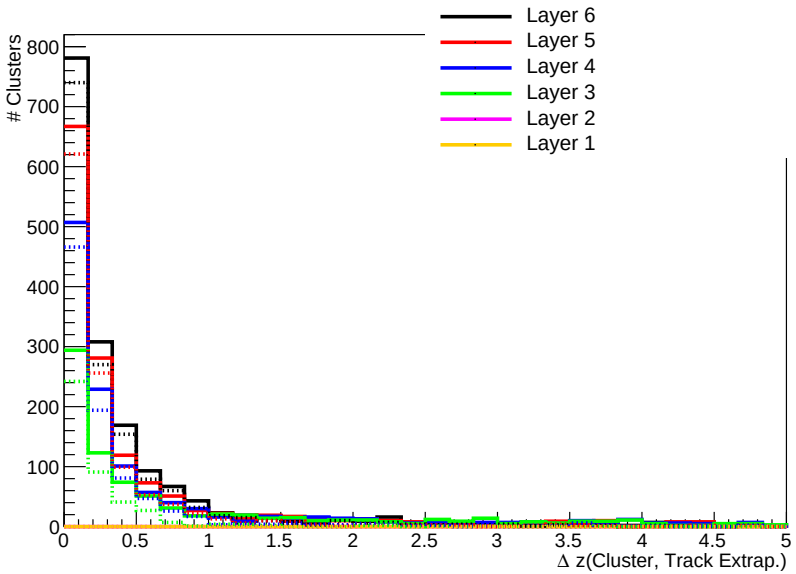
DAF vs. Kalman Fitter

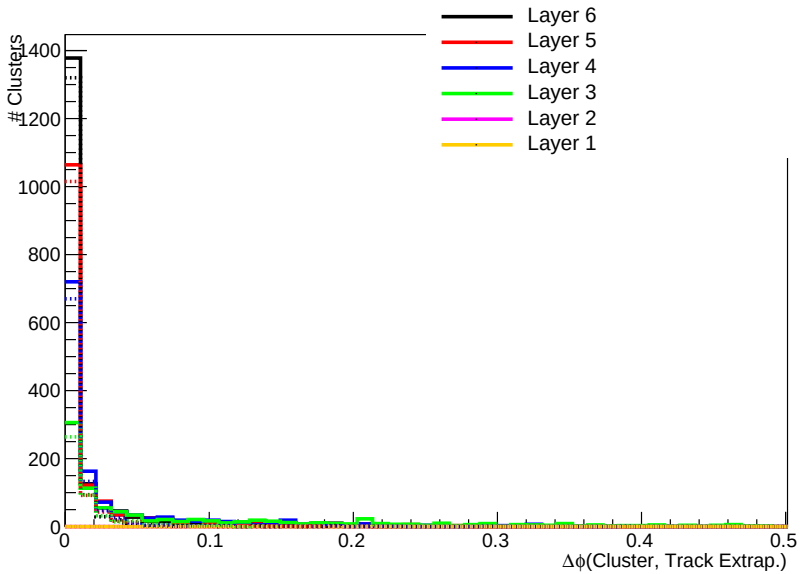




- Added option to fit with DAF, here show comparison of the DAF (left) and Kalman (right) track refits
- DAF refits basically all the tracks, Kalman better than before (halved search size) but still failing nearly 1/3 of the time

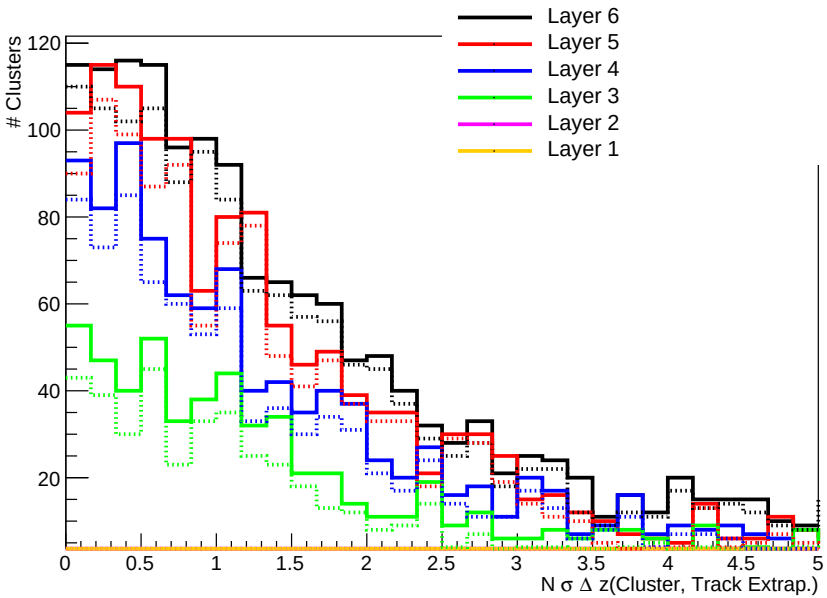
Distance of hits to extrapolated track

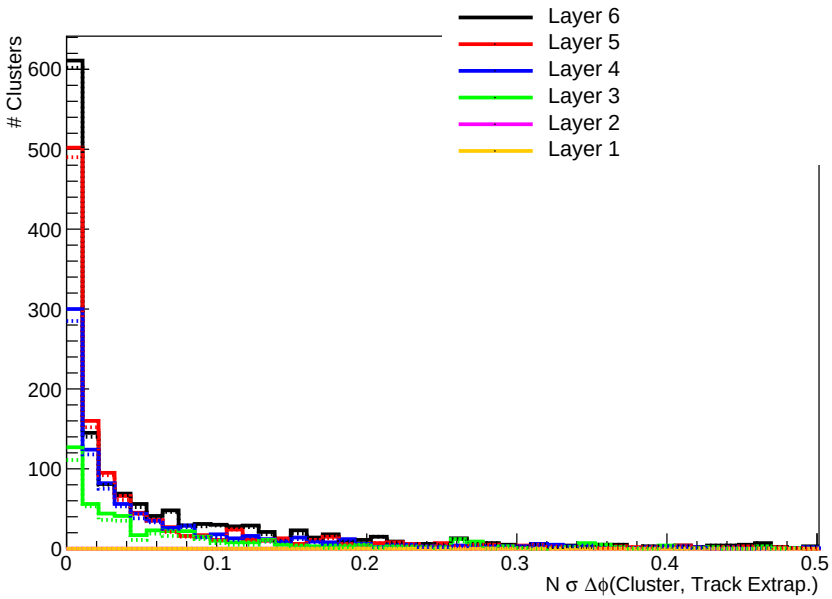




- Was doing the xy hits in terms of distance on the xy plane
- But the detector plane will actually be slanted, i.e. not exactly at cylinder of extrap for whole detector, so xy distance a bad measure
  - Now look at $\Delta\phi$ instead
- As expected, the avg. distance to the hit grows as you move down layers (not including new hit info in extrapolation)
- Dotted line shows distribution of clusters truth matched to the track
  - For z clusters: N clusters: 5448, N matched: 3966, Matched fr: 0.728
  - For ϕ clusters: N clusters: 5448, N matched: 4062, Matched fr: 0.746

N σ_d of hits to extrapolated tracks





- Show again the distance between hits and tracks, this time in terms of track uncertainties from covariance given by genfit extrapolation
  - $\sigma_{\Delta z} = \sigma_{z_t}$, where z_t is z of track
  - $\sigma_{\Delta\phi} = \frac{1}{r_t^2}\sqrt{y_t^2\sigma_{x_t}^2 + x_t^2\sigma_{x_t}^2 - 2x_t y_t V_{x_t y_t}}$, V the covariance
- For Δz, uncertainties are slightly larger than 1, but shape for each layer the same; for $\Delta\phi$, uncertainties are too large
- Dotted line shows distribution of clusters truth matched to the associated track