

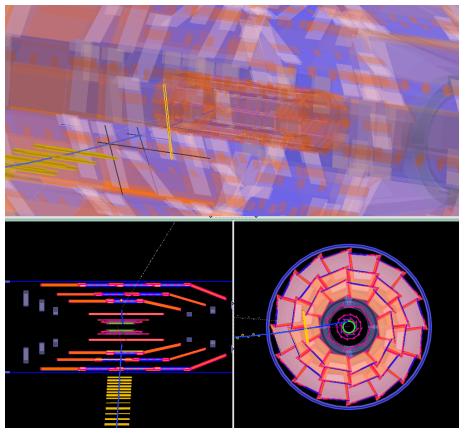
VXD Hit Recovery

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Project Goals (to check my own understanding)

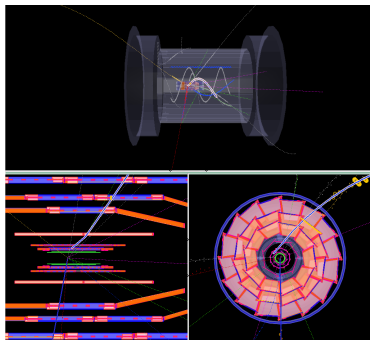


Example: pion from K_S decays between layer 3 & 4, not found by VXD track finder

- 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
- Idea for this project is to create a module to take CDC-only tracks and extrapolate back into VXD, create new track adding compatible VXD hits

- Have done some work building a module, to familiarize myself with the B2 software and tracking objects, & start on simple implementation
- Started by finding CDC-only reco'd tracks w/MC hits in VXD
- Added VXD hits to track and refit
 - Just so can obtain StoreArray objects, find hits, do some basic work with tracks, and some comparison point
- Next, took above tracks (w/o MC hits), extrapolated from last CDC-hit to cylinder w/radius of SVD layers, & searched for hits:
 - Use `genfit::TrackRep::extrapolateToCylinder` for extrap.
 - Start with layer 6 v-clusters, find one closest in z to extrapolated position, and within one module width in x/y
 - Search for nearest (in x/y) u-cluster on same sensor
 - If a u and v found, add them to the track, repeat for other layers
 - Currently, only for SVD layers
- All of the above procedure done on the GenFitterModule tracks
 - Clone, add hits, refit (code taken from GenFitter, passing them through for another round of fitting wasn't working for me)

Example output: $B^\pm \rightarrow DK^\pm$, $D^0 \rightarrow K_S \pi^+ \pi^-$



True Production Position:

$(x, y, z) = (1.29, 4.45, 3.68)$ cm

CDC-only extrapolated position:

$(x, y, z) = (1.44, 4.67, 3.29)$ cm

VXD+CDC extrap'd position:

$(x, y, z) = (1.27, 4.45, 3.70)$ cm

- Run the SVD hit adder on evtgen events with one $B^\pm \rightarrow DK^\pm$, $D^0 \rightarrow K_S \pi^+ \pi^-$ (a mode for ϕ_3)
- Example full event with K_S decaying on layer 3, giving pion without a VXD track, but with recoverable hits
- In this case, all clusters recovered (based on associated MC particle) with no additional clusters
- For both the CDC-only and VXD+CDC track, try to extrapolate to known production point, ie with `genfit::TrackRep::extrapolateToPoint`

Further work/questions

- Occasionally, I get refit failures
 - The example shown was hand-picked
 - Should be producing `genfit::TrackCand` and passing back to GenFitter module anyway?
 - Anyway, need to be smarter with the hit selection, can get an extra hit layer from random hit on module far from extrapol. point
 - Also, does there exist a way to test if a hit has already been used in a track?
- Cylinder extrapolation okay for main barrel modules, but to slant modules?
 - Requires adding something like a `genfit::TrackRep::extrapolateToCone?`
- Further down the road, ultimately, want answer to questions:
 - How often do we have CDC-only tracks w/VXD hits in MC?
 - Given a module like that presented, how often do we recover these hits?
 - How often do we add spurious hits?
 - Some test cases for the module: K_S resolution or similar?