# Displaced Vertex

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# Secondary Vertex Finder

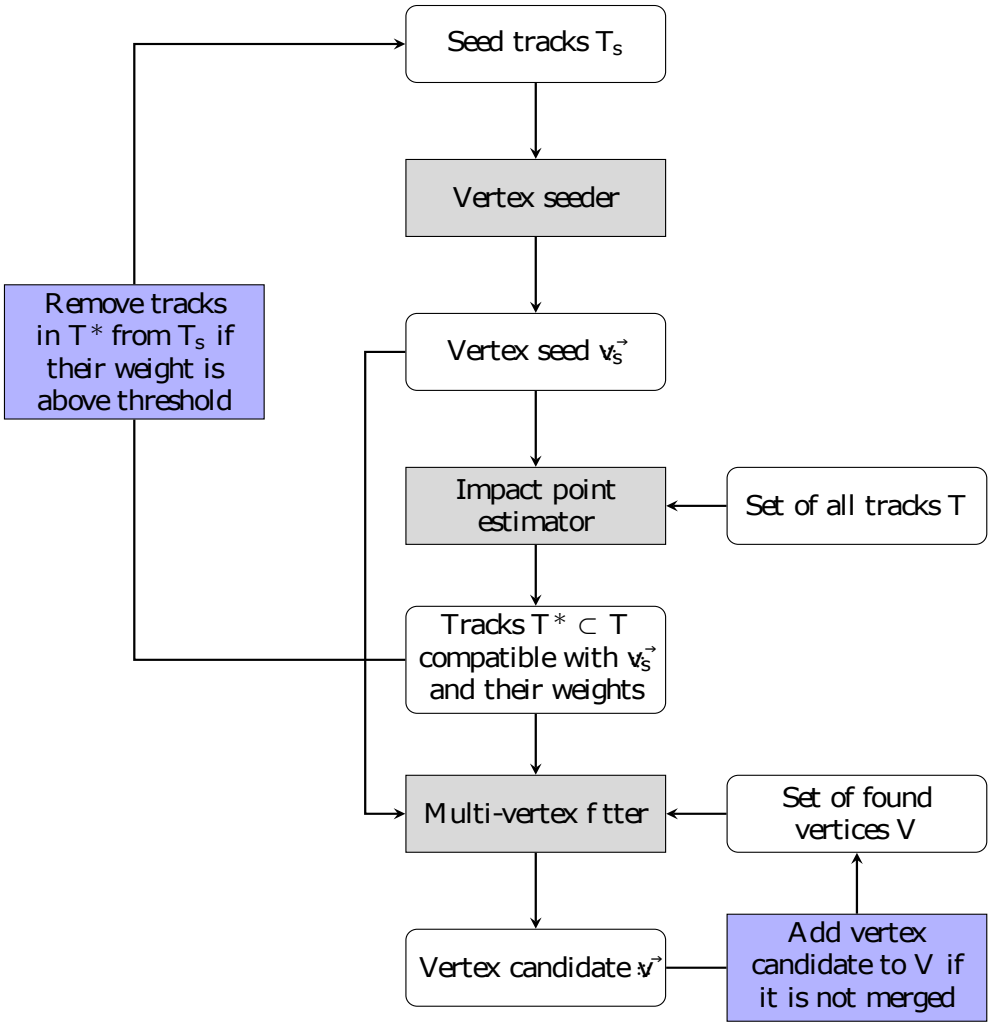
## Nature of the Study

- Implemented the `ACTS::AdaptiveMultiVertexFinder`
- Feed in `CentralTrackVertices`, `ReconstuctedParticleCollection`, `Trajectories` from the primary vertex `IterativeVertexFinder` `&TrackParameters`
- Using two track vertices: $K\pi$
- Presented some rudimentary displaced vertex $(x, y, z)$
- Input file: enriched $D^0$ sample

  `pythia8NCDIS_18x275_minQ2=10_beamEffects_xAngle=-0.025_hiDiv_1.hepmc3.MC.root`

  (Rongrong)

# Adaptive Multi-VertexFinder (AMVF)




- Based on weighted adaptive Kalman filter with deterministic annealing
- Removeable beamspot constraint (useful for secondary vertices)
- Gaussian track density seed finder to estimate vertex position
- Check compatibility of tracks with seeder (assign weight if compatible)
- Simultaneous refit of all previously found vertices and vertex seed
- After convergence of fit, check whether the vertex candidate is merged with other vertices, discard if merged
- Remove seed tracks if their weights are above threshold

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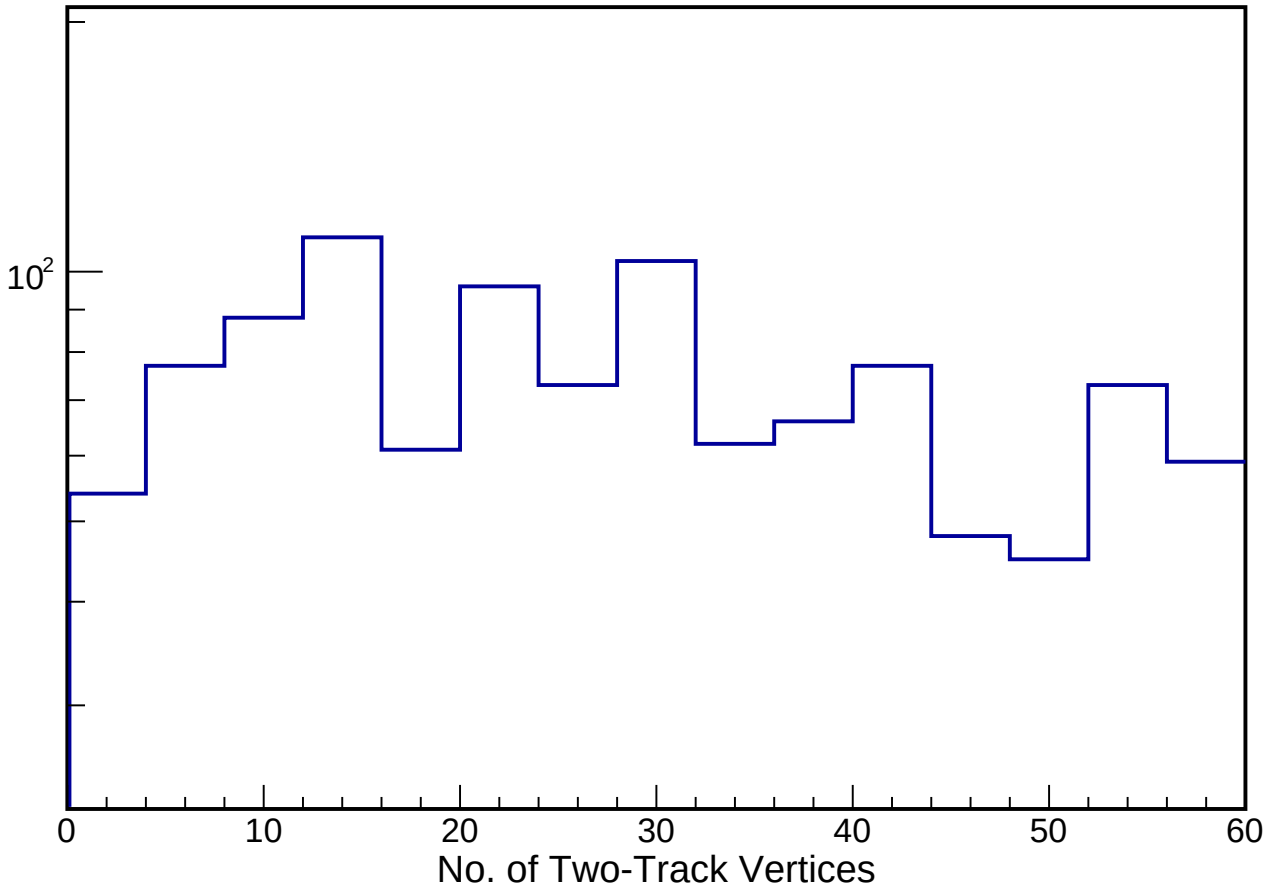
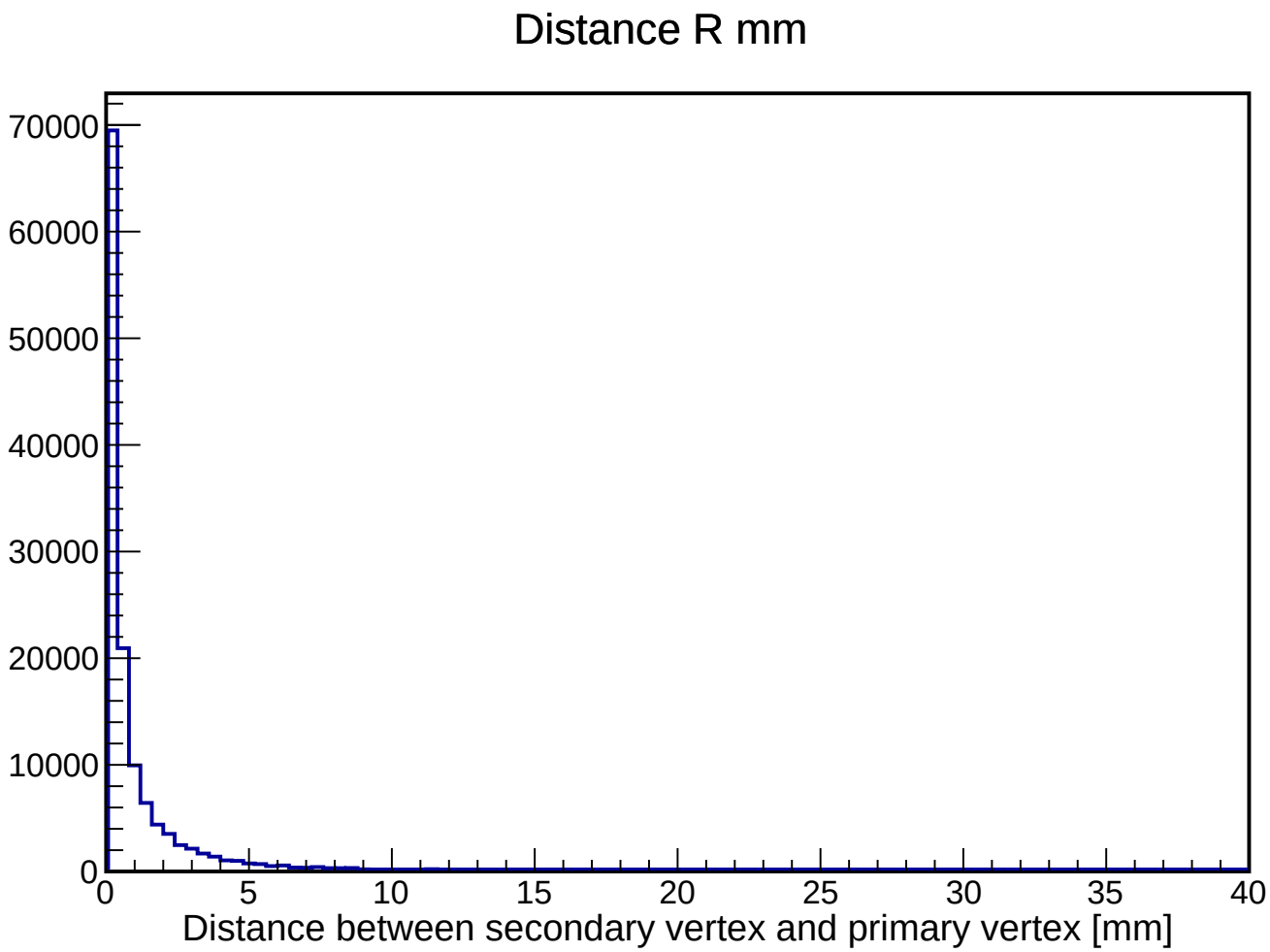
# Two-Track Secondary Vertex Multiplicity

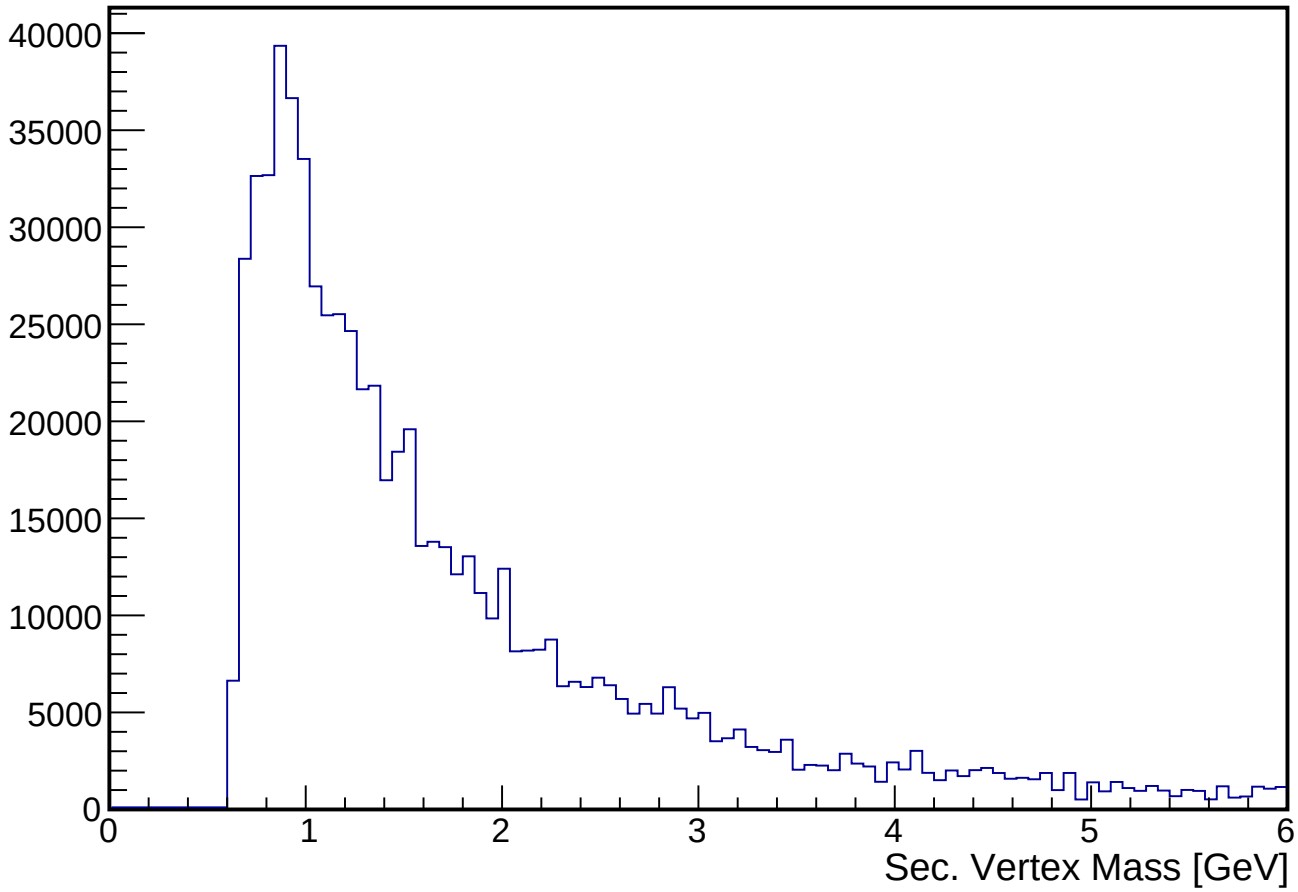



- Number of two-track vertices per event is quite high
- No cuts or conditions applied to this histogram
- This can be cleaned up by utilising annealing methods AMVF

# 3D Distance between Secondary & Primary Vertex

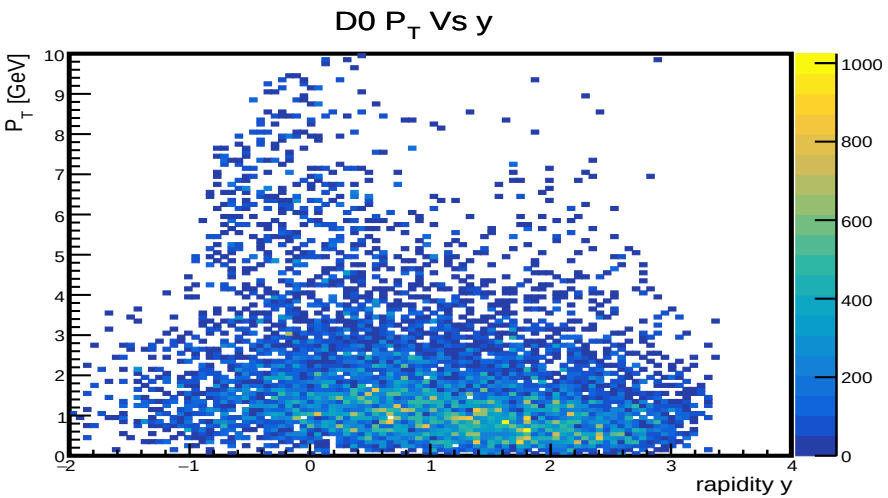


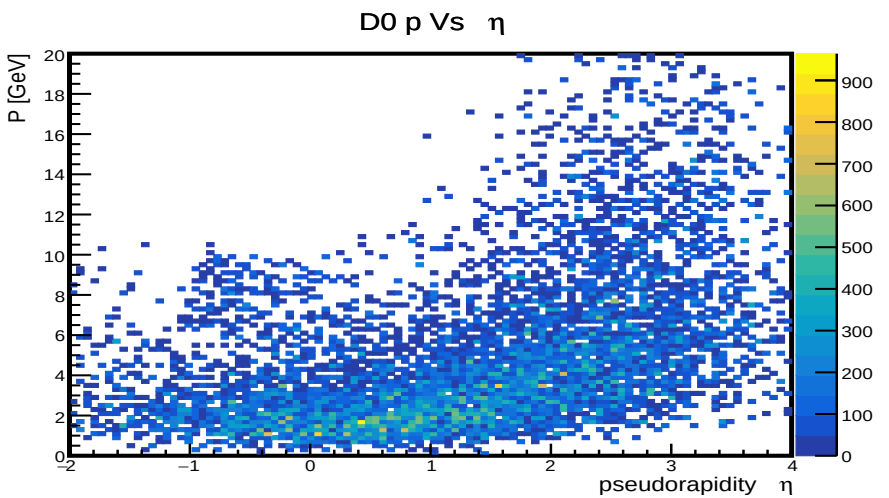
# SV Mass

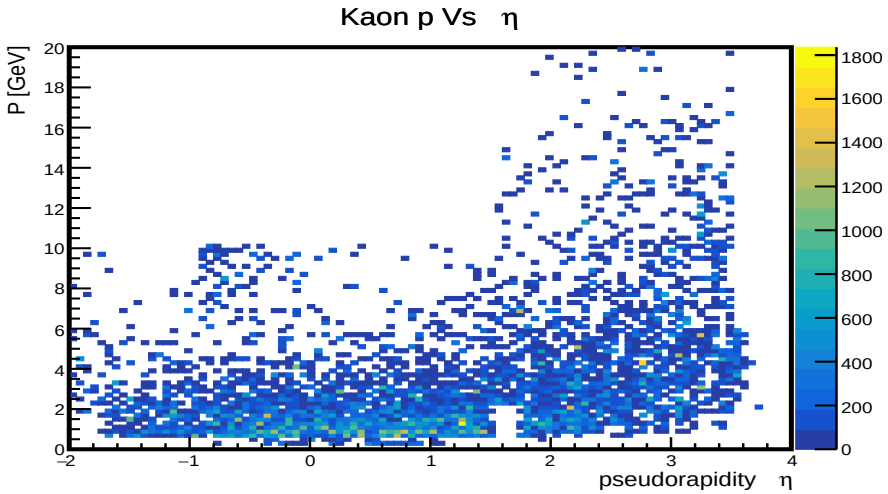


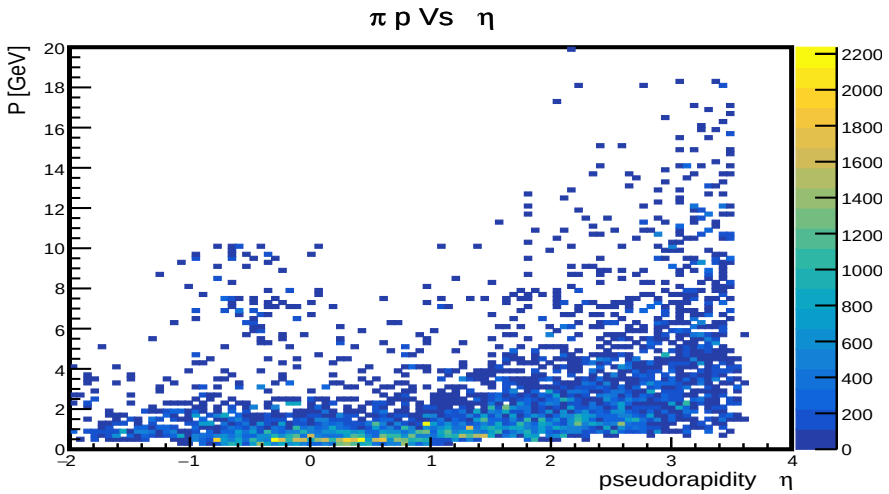

- Invariant mass of the tracks in the secondary vertex

# Kinematics Plots



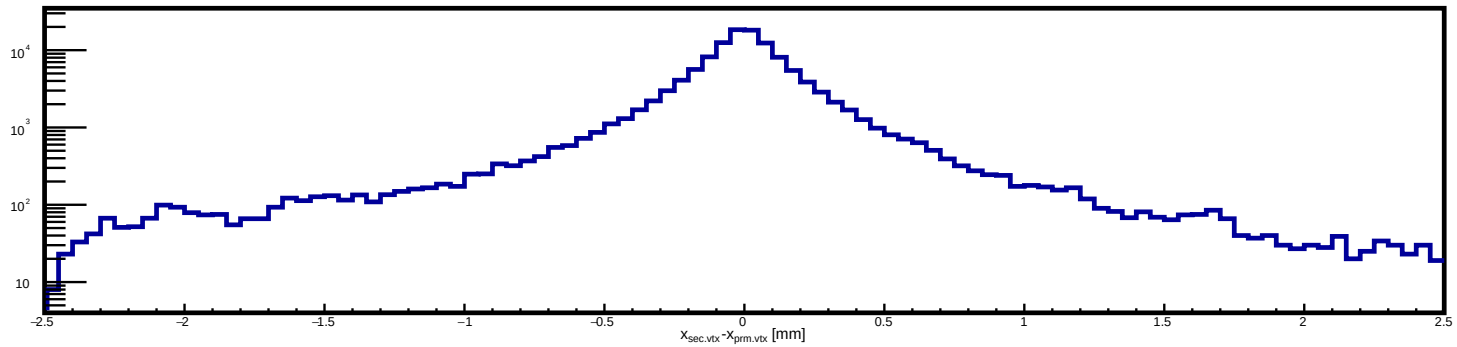



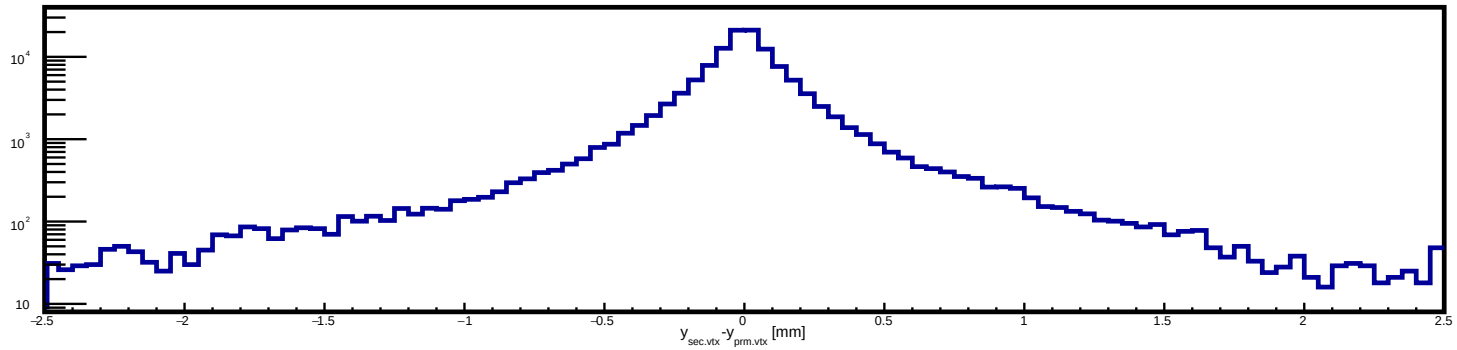

- Top panel: $D^0$ kinematics
- Bottom panel: reconstructed daughter $D^0$ p vs η

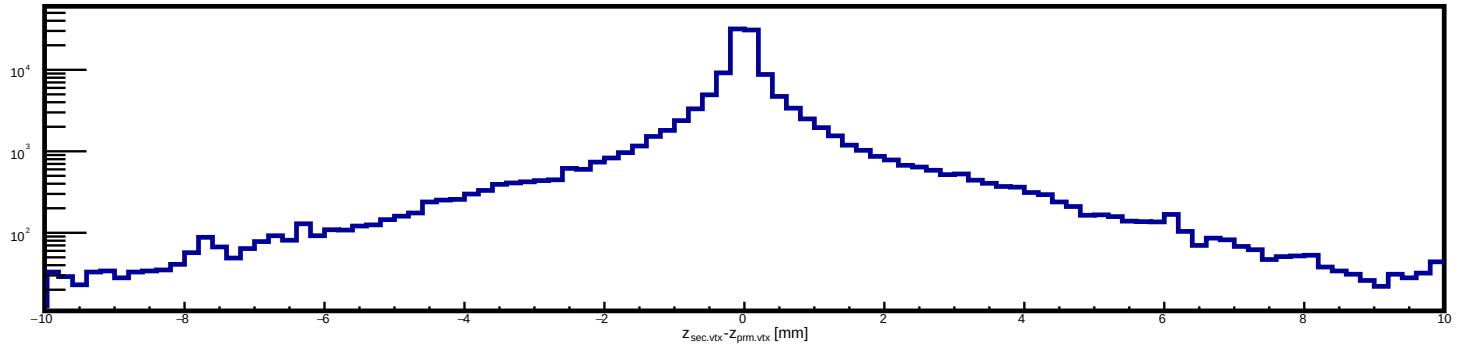
# Next steps

- Complete PV evaluation with AMVF and compare to existing results
- Compare SV with Helix calculations
- Include 3-prong events

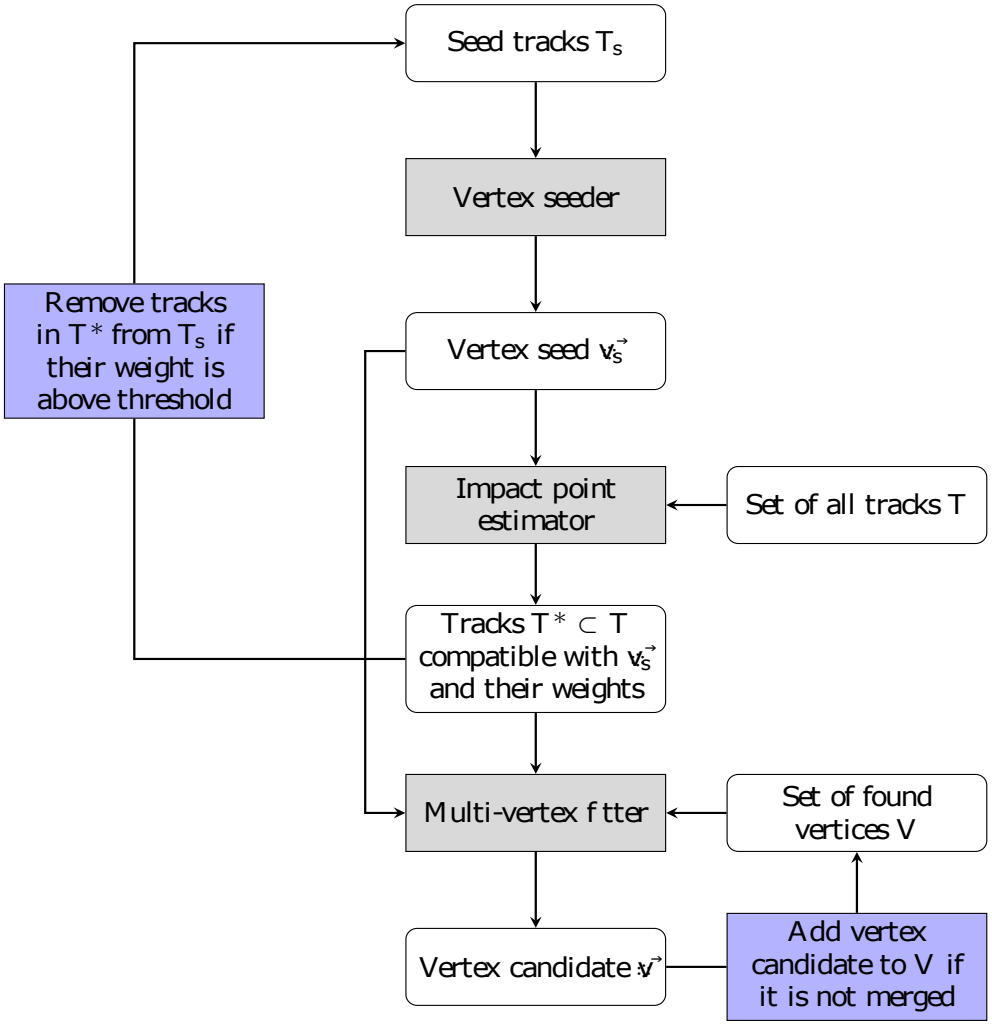
# SV - PV Coordinate



# Adaptive Multi-VertexFinder (AMVF)




- Weighted adaptive Kalman filter with deterministic annealing
- Removeable beamspot constraint (useful for secondary vertices)
- Gaussian track density seed finder
- Simultaneous refit of all vertices connected through a chain of vertices and tracks with weights:

$$\omega_i(\chi_i^2, T) = \frac{e^{-\frac{1}{2}\chi_i^2/T}}{\sum_j e^{-\frac{1}{2}\chi_j^2/T} + e^{-\frac{1}{2}\chi_0^2/T}}$$

- Merge vertices if they are close enough

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