

SV container in AMVF factory

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25/08/26

Update of AMVF Algorithm #2641

 Open



ruse-traveler opened on Apr 28

Last edited by **veprbl** 

Member



Following the merge of [#1915](#). There are 2 updates to the algorithm to keep in our field of vision:

- ☐ Wiring in the Secondary Vertex EDM when ready so that the AMVF and Helix Swimmer algorithms can be easily compared (critical); and 
- ☒  [refactor: merge AMVF code paths for primary and secondary vertexing #2677](#) Deduplicating code between the primary and secondary vertexing modes (not critical, but preferable). 

Create sub-issue 



So far:

- [Secvertex amvf merged into main ElCrecon repo- #1915](#)
- [refactor: merge AMVF code paths for primary and secondary vertexing- #2677](#)

Resulting in:

- algorithms/tracking/SecondaryVertexFinder.cc
- algorithms/tracking/SecondaryVertexFinder.h
- algorithms/tracking/SecondaryVertexFinderConfig.h
- factories/tracking/SecondaryVertexFinder_factory.cc

Setting: EDM4eic

```
edm4eic::Vertex:
Description: "EIC vertex"
Author: "J. Osborn"
Members:
- int32_t      type           // Type flag, to identify what type of vertex it is (e.g. primary, secondary, generated, etc.)
- float        chi2           // Chi-squared of the vertex fit
- int          ndf            // NDF of the vertex fit
- edm4hep::Vector4f position // position [mm] + time t0 [ns] of the vertex. Time is 4th component in vector
## this is named "CovMatrix" in EDM4hep, renamed for consistency with the rest of edm4eic
- edm4eic::Cov4f positionError // Covariance matrix of the position+time. Time is 4th component, similarly to 4vector
OneToManyRelations:
- edm4eic::ReconstructedParticle associatedParticles // particles associated to this vertex.
```

```
edm4eic::SecondaryVertex:
Description: "EIC secondary vertex"
Author: "X. Dong"
Members:
- int32_t      type           // Type flag, to identify what type of vertex it is (e.g. primary, secondary, genera
- float        chi2           // Chi-squared of the vertex fit
- int          ndf            // NDF of the vertex fit
- edm4hep::Vector4f position // position [mm] + time t0 [ns] of the vertex. Time is 4th component in vector
- edm4eic::Cov4f positionError // Covariance matrix of the position+time. Time is 4th component, similarly to 4vect
- edm4hep::Vector3f parentMomentum // parent momentum
- float        parentInvariantMass // parent invariant mass
- float        parentInvariantMassError // parent invariant mass error
- float        parentDecayLength // parent decay length
- float        parentDecayLengthError // parent decay length error
- float        parentDca2PV // parent dca to primary vertex
- float        parentDca2PVError // parent dca_error to primary vertex
VectorMembers:
- edm4hep::Vector3f daughterMomentum // daughter track momentum at the decay vertex
- int              daughterPDG // daughter PDG
- float            daughterDca2PV // daughter dca to primary vertex
- float            daughterDca2PVError // daughter dca_error to primary vertex
- int              daughterPairIndices // track indices for any pair
- float            daughterPairDca // dca between any pair of tracks
- float            daughterPairDcaError // dca_error between any pair of tracks
OneToManyRelations:
- edm4eic::Vertex primaryVertex // associated primary vertex
OneToManyRelations:
- edm4eic::ReconstructedParticle associatedParticles // particles associated to this vertex.
```

- Due to [refactor: merge AMVF code paths for primary and secondary vertexing- #2677](#) , PV and SV use the same collection output.
- Temporary solution to work: combine PV and SV containers into one
 - [add-sv-containter-efmc](#)

```
# Note: I will merge both structures such that can be used in conjunction with the SV finder
edm4eic::Vertex:
  Description: "EIC general vertex container"
  Author: "J. Osborn, X. Dong"
  Members:
    - int32_t          type          // Type flag, to identify what type of vertex it is (e.g. primary, secondary, generated, etc.)
    - float            chi2          // Chi-squared of the vertex fit
    - int              ndf           // NDF of the vertex fit
    - edm4hep::Vector4f position     // position [mm] + time t0 [ns] of the vertex. Time is 4th component in vector
    - edm4eic::Cov4f   positionError // Covariance matrix of the position+time. Time is 4th component, similarly to 4vector
    - edm4hep::Vector3f parentMomentum // parent momentum
    - float            parentInvariantMass // parent invariant mass
    - float            parentInvariantMassError // parent invariant mass error
    - float            parentDecayLength // parent decay length
    - float            parentDecayLengthError // parent decay length error
    - float            parentDca2PV // parent dca to primary vertex
    - float            parentDca2PVErr // parent dca_error to primary vertex
  VectorMembers:
    - edm4hep::Vector3f daughterMomentum // daughter track momentum at the decay vertex
    - int              daughterPDG // daughter PDG
    - float            daughterDca2PV // daughter dca to primary vertex
    - float            daughterDca2PVErr // daughter dca_error to primary vertex
    - int              daughterPairIndices // track indices for any pair
    - float            daughterPairDca // dca between any pair of tracks
    - float            daughterPairDcaError // dca_error between any pair of tracks
  OneToOneRelations:
    - edm4eic::Vertex associatedPrimaryVertex // associated primary vertex
  OneToManyRelations:
    - edm4eic::ReconstructedParticle associatedParticles // particles associated to this vertex.
```

- Current implementation of the new container in ElCrecon is in [implement-svcontainer-output](#)
- Implementations to the algorithm:

```
void storeVertices(const std::vector<Acts::Vertex>& vertices,  
                  const edm4eic::ReconstructedParticleCollection& reconParticles,  
                  edm4eic::VertexCollection& outputVertices, int vertexType) const;  
  
void storeSecondaryVertices(const std::vector<Acts::Vertex>& primaryVertices,  
                            const std::vector<Acts::Vertex>& secondaryVertices,  
                            const edm4eic::ReconstructedParticleCollection& reconParticles,  
                            edm4eic::VertexCollection& outputVertices, int vertexType) const;
```

- Current implementation of the new container in ElCrecon is in [implement-svcontainer-output](#)
- Implementations to the algorithm:

```
for (const auto& trkPar : trkPars) {  
    const double EPSILON = 1.0e-4; // mm  
  
    if (std::abs((trkPar.getLoc().a / edm4eic::unit::mm) -  
                (loc_a / Acts::UnitConstants::mm)) < EPSILON &&  
        std::abs((trkPar.getLoc().b / edm4eic::unit::mm) -  
                (loc_b / Acts::UnitConstants::mm)) < EPSILON) {  
        trace("From ReconParticles, track local position [Loc a, Loc b] = {} mm, {} mm",  
              trkPar.getLoc().a / edm4eic::unit::mm,  
              trkPar.getLoc().b / edm4eic::unit::mm);  
        trace("Reco track local position from vertex = {} mm, {} mm",  
              trkPar.getLoc().a / edm4eic::unit::mm,  
              trkPar.getLoc().b / edm4eic::unit::mm);  
  
        daughters.emplace_back(part);  
    }  
}
```

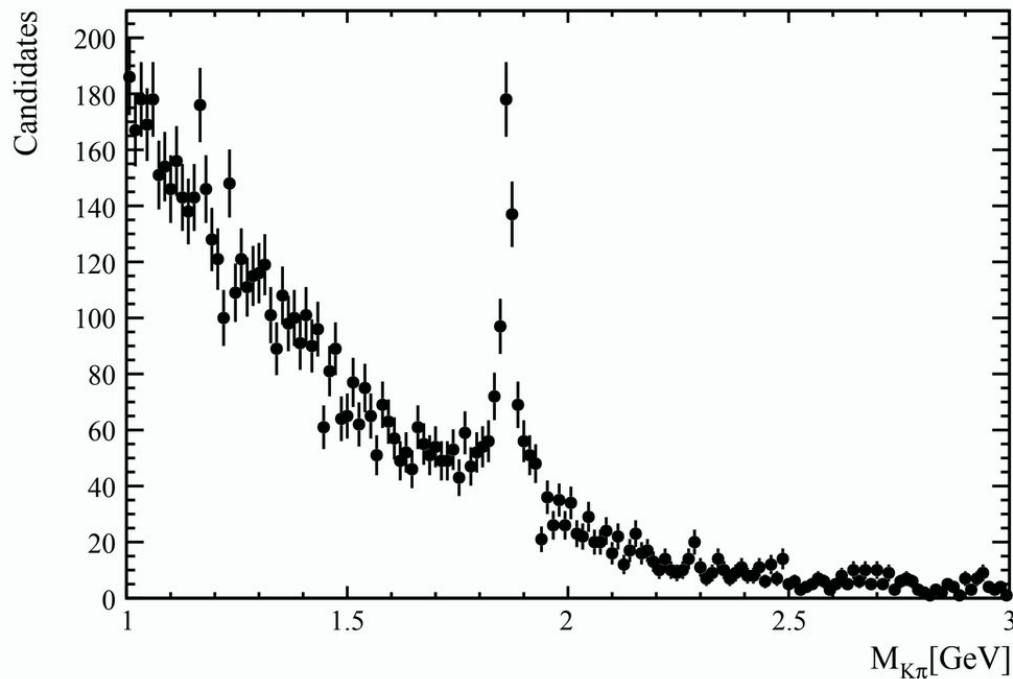
- Currently, the distributions do not look good
- Still investigating what is going on.
 - Should I use the ReconstructedParticles or Tracks used in the AMVF finder to calculate parent and daughter kinematics?
 - Should I use a different geometry of the detector
 - Implementation of Acts::ImpactPointEstimator for DCAs?
- Besides this, the infrastructure of the code is good and working.
- Note: working with a custom EDM4eic in the eic-shell is a bit of a pain at the beginning so I made some notes to make it work.

September 22nd

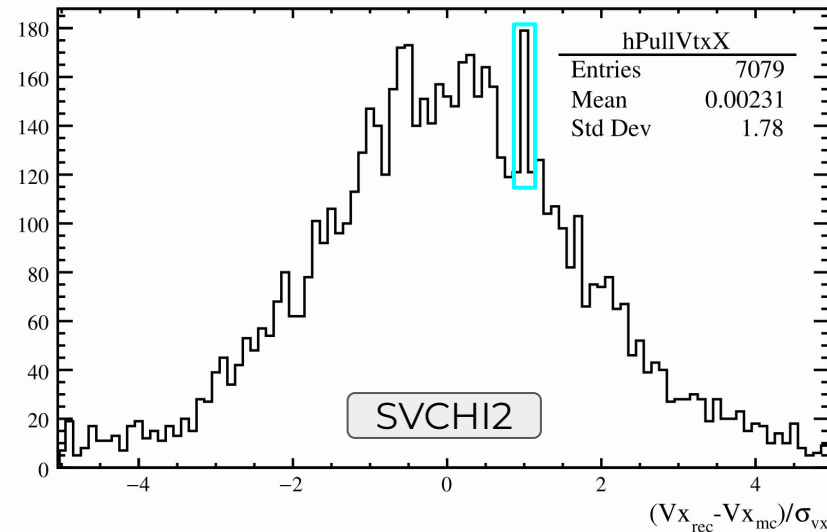
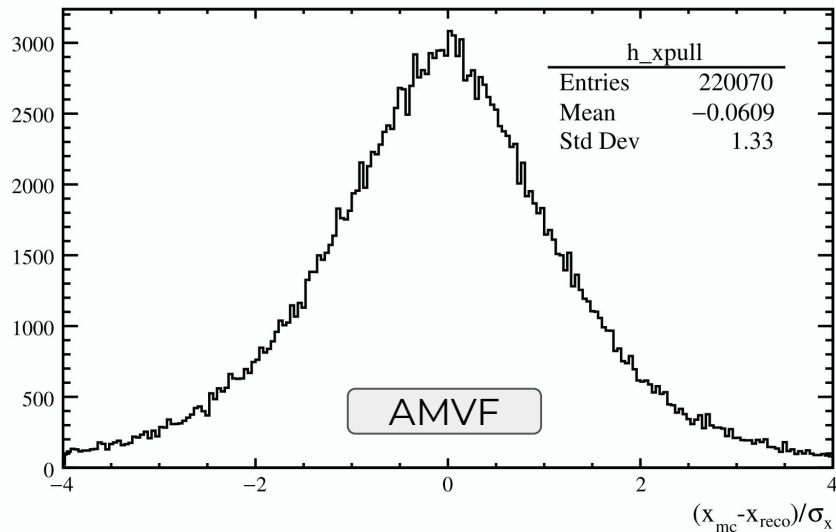
- Now using D0 sample. Sample obtained from [this code](#)
- Invariant mass of D0 has been obtained successfully
- Pull distributions are available to compare with Chi2 method

Previously, the invariant mass was not seen.

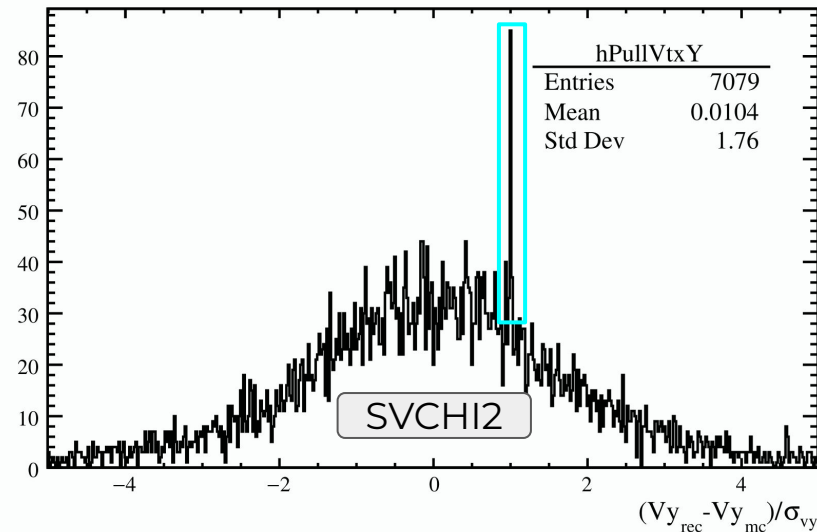
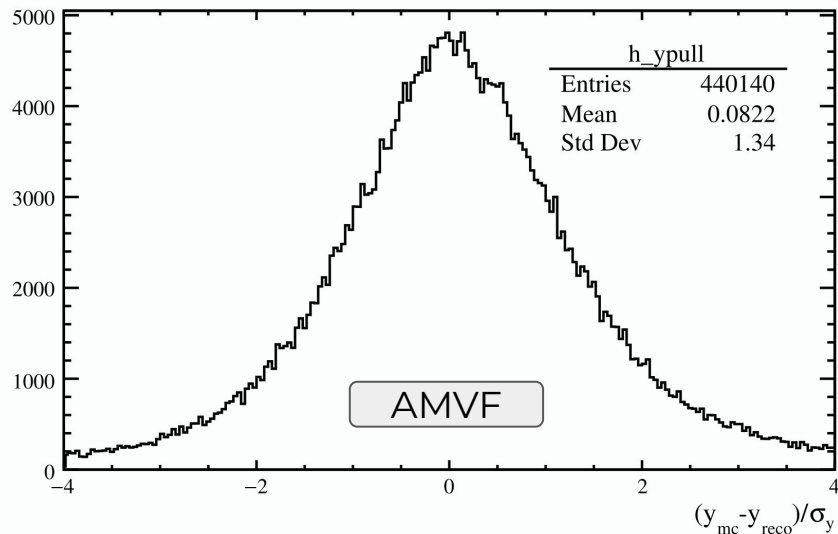
- Lambda sample did not display mass
- D0 does show invariant mass peak.



Pull distributions



Pull distributions



Pull distributions

