

Muon Collider Full Simulation Studies

Shivani Lomte

July 15, 2021

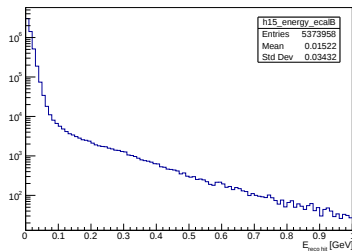
Status

Able to submit jobs now, generating large statistics (20k events so far) for $\mu^+\mu^- \rightarrow \nu\bar{\nu}HH \rightarrow \nu\bar{\nu}b\bar{b}b\bar{b}$ process.

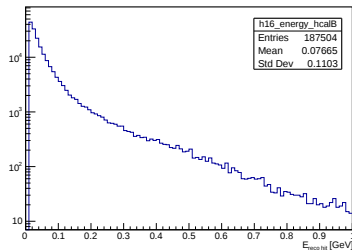
Literature suggests that timing information and energy threshold selection in calorimeters can suppress BIB. Following plots are for BIB only. HH signal plots will be analyzed next.

hit energy in Calorimeter

Hit energy (ECAL Barrel)



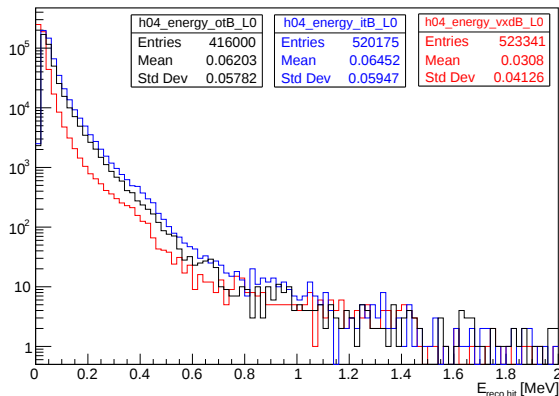
Hit energy (HCAL Barrel)



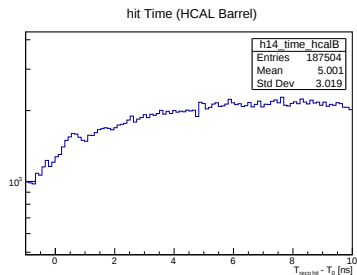
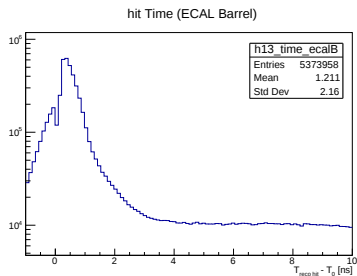
hit energy in Tracker

Inner Tracker, Outer Tracker, Vertex Detector,

Hit energy (VXD Barrel L0)



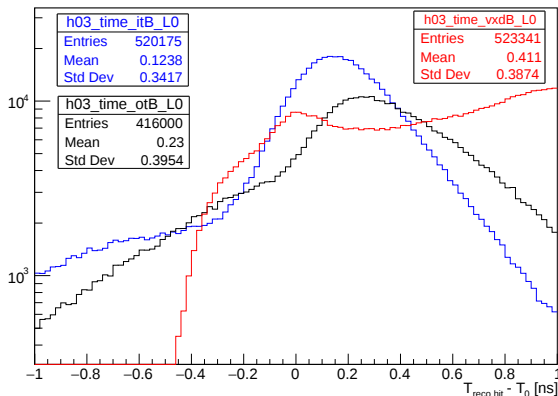
hit time in Calorimeter



hit time in Tracker

Inner Tracker, Outer Tracker, Vertex Detector,

hit Time (Tracker)



Next Steps

Analyze HH signal event and compare hit time and energy plots with BIB.

Studyjet reconstruction performance of HH process with and without BIB.

Add gen jet branch in ntuples file.

Adding gen jets to ntuples

reco steering file:

```
<!-- ===== -->
<!-- ===== -->
<!-- == Jet reconstruction configuration == -->
<!-- ===== -->
<!-- ===== -->

<!-- ===== Rename collection (to have same output collection name as FastJet) ===== -->

<processor name="RenameCollection" type="MergeCollections">
  <parameter name="CollectionParameterIndex" type="int">0 </parameter>
  <parameter name="InputCollectionIDs" type="IntVec"> </parameter>
  <parameter name="InputCollections" type="StringVec"> PandoraPFOs </parameter>
  <parameter name="OutputCollection" type="string"> PFOsFromJets </parameter>
</processor>

<!-- ===== Jet clustering for gg->hadrons removal ===== -->
<processor name="MyFastJetProcessor" type="FastJetProcessor">
  <parameter name="algorithm" type="StringVec"> ValenciaPlugin 1.2 1.0 0.7 </parameter>
  <parameter name="clusteringMode" type="StringVec"> ExclusiveNJets 2 </parameter>
  <parameter name="recombinationScheme" type="string">E_scheme </parameter>
  <parameter name="recParticleIn" type="string" lcioInType="ReconstructedParticle"> TightSelectedPandoraPFOs </parameter>
  <parameter name="jetOut" type="string" lcioOutType="ReconstructedParticle"> JetsAfterGamGamRemoval </parameter>
  <parameter name="storeParticlesInJets" type="boolean" > true </parameter>
  <parameter name="recParticleOut" type="string" lcioOutType="ReconstructedParticle"> PFOsFromJets </parameter>
</processor>
```

lctuple steering file:

```
<processor name="MyFastJetProcessor" type="FastJetProcessor">
  <parameter name="algorithm" type="StringVec">antikt_algorithm 1.3</parameter>
  <parameter name="clusteringMode" type="StringVec"> Inclusive 5</parameter>
  <parameter name="jetOut" type="string" lcioOutType="ReconstructedParticle">JetOut </parameter>
  <parameter name="recParticleIn" type="string" lcioInType="ReconstructedParticle"> PandoraPF0s </parameter>

  <parameter name="recombinationScheme" type="string">E_scheme </parameter>
</processor>

<processor name="MyLCIOOutputProcessor" type="LCIOOutputProcessor">
  <parameter name="LCIOOutputFile" type="string">outputfile.slcio </parameter>
  <parameter name="LCIOWriteMode" type="string">WRITE_NEW</parameter>
  <!--parameter name="SplitFileSizeKB" type="int">1992294 </parameter-->
</processor>
```

JetBranches.cc in LCTuple:

```
//----- fill the Jets -----  
for(size_t i=0 ; i < _nj ; ++i) {  
  
    lcio::ReconstructedParticle* jet = static_cast<lcio::ReconstructedParticle*>( col->getElementAt(i) ) ;  
  
    // Write default jet parameters  
    _jmox[ i ] = jet->getMomentum()[0];  
    _jmoy[ i ] = jet->getMomentum()[1];  
    _jmoz[ i ] = jet->getMomentum()[2];  
    _jmas[ i ] = jet->getMass();  
    _jene[ i ] = jet->getEnergy();  
    _jcha[ i ] = jet->getCharge();  
    _jcov0[ i ] = jet->getCovMatrix()[0];  
}
```