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Z Reconstruction for Analysis Skims

Complete: 

Introduction

This document is a proposal for a AOD extension for analysis studies using the Z. AOD extensions will be produced as output of central skim production during CSA07, and can be configured for specific analysis requirements.

We propose to add to the standard AOD reconstructed Z candidates, Monte Carlo match maps and other possible event contents useful for analysis.

Z reconstruction

Z reconstruction in decays $Z \rightarrow \mu^+\mu^-$ and $Z \rightarrow e^+e^-$ can be performed with the common combiner modules provided with the PhysicsTools toolkit using as input the standard collections `globalMuons` and `pixelMatchGsfElectrons` respectively. Mild invariant mass cuts can be set in order to leave a sufficient amount of side-band events. We set for all Z collection the cut:

- **mass > 20 GeV/c².**

Configuration fragments could be the following:

- [zToMuMu.cfi](#)
- [zToEE.cfi](#)

Loose Z reconstruction

Z reconstructed from a track plus a lepton or a super-cluster plus an electron could also be useful as "loose" Z sample. An isolation cut on the track would help reducing the combinatorial background, and should be considered (it is not applied at the moment).

The following scripts can be added, and optionally included in the actual skim process:

- [zToMuMuOneTrack.cfi](#)
- [zToEEOneTrack.cfi](#)
- [zToMuMuOneStandAloneMuonTrack.cfi](#)
- [zToEEOneSuperCluster.cfi](#)

MC truth

Monte Carlo truth matching in form of one-to-one association map can be stored together with reconstructed candidate collections. The matching is based on the ΔR distance, and a cut $\Delta R < 0.15$ is used in most of the analysis studies presented up to now.

Lepton MC truth matching

Separate match maps for electrons and muons can be stored. Configuration fragments may be the following:

- [allMuonsGenParticlesMatch.cfi](#)
- [allElectronsGenParticlesMatch.cfi](#)
- [allTracksGenParticlesLeptonMatch.cfi](#)

- [allStandAloneMuonTracksGenParticlesLeptonMatch.cfi](#)
- [allSuperClustersGenParticlesLeptonMatch.cfi](#)

Match map definitions are located in the common package:

- [CMS.PhysicsTools/HepMCCandAlgos](#)

Z MC truth matching

Separate match maps for Z $\mu^+\mu^-$ and Z e^+e^- can be stored, if we want to keep separate Z candidate collections. Configuration fragments may be the following:

- [zToMuMuGenParticlesMatch.cfi](#)
- [zToMuMuOneTrackGenParticlesMatch.cfi](#)
- [zToMuMuOneStandAloneMuonTrackGenParticlesMatch.cfi](#)
- [zToEEGenParticlesMatch.cfi](#)
- [zToEEOneTrackGenParticlesMatch.cfi](#)
- [zToEEOneSuperClusterGenParticlesMatch.cfi](#)

Lepton isolation

generic isolation modules are been defined in the packages:

- [CMS.PhysicsTools/IsolationUtils](#)
- [CMS.PhysicsTools/IsolationAlgos](#)

Isolation information could also be used to preselect tracks to be used for "loose" Z reconstruction.

For the moment, the following isolation modules, based on p_t sum, are added to `ZReco`:

- [allMuonIsolations.cfi](#)
- [allElectronIsolations.cfi](#)
- [allTrackIsolations.cfi](#)
- [allStandAloneMuonTrackIsolations.cfi](#)
- [allSuperClusterIsolations.cfi](#)

We could probably save some CPU time not computing isolation for all tracks, but for all tracks above a specified p_t threshold.

Isolation definitions are located in the common package:

- [CMS.PhysicsTools/IsolationAlgos](#)

More possible extensions

Further analysis information can be computed on AOD plus the Analysis Collections mentioned above.

Z common vertex fit

Kalman or Gsf common vertex fit can be applied to reconstructed Z with an available module. Whether the Z vertex fit is actually needed, and/or should run at the level of skimming is matter of discussion within the EWK group.

Skim Event Content

The skim output consists of the standard AOD plus all the collections produced by the analysis sequences (lepton, Z candidates, isolations, MC truth match maps).

Package organization

A new package containing `.cfi` and in the future possibly algorithms (if any) has been created:

- [ElectroWeakAnalysis/ZReco](#)

We don't need new data formats definition, at the moment, since all output types dictionaries are defined in standard packages.

Event filtering

It is possible to filter only events where a reconstructed Z is present if the input data set is a mixture ("soup") of different processes. Filtering can be managed with the use of generic filter modules. The actual event filtering criteria have to be defined within the EWK group.

For the moment, all events with one Z or a "loose" Z are written to disk.

Running test skims on 1_5_X

A few tags are needed on top of release 1_5_2 The following recipe can be used:

```
scramv1 project CMSSW CMSSW_1_5_2
cd CMSSW_1_5_2/src
project CMSSW
cvs co -r EWK_1_5_0_pre6 CMS.PhysicsTools ElectroWeakAnalysis
eval `scramv1 run -csh`
scramv1 b
cd ElectroWeakAnalysis/ZReco/test
```

Run the test script:

```
cmsRun testZtoEEReco.cfg
```

The `.cfg` scripts under the `test` directory will run on a standard Z e^+e^- release validation sample (that is what is available in the official 1_5_0_preX production up to now...). So, the script `testZtoMuMuReco.cfg` will run, but will likely not reconstruct any Z candidate.

Running test skims on 1_3_5

Releases 1_5_0 and 1_6_0 can't read data produced with release 1_3_X. Release 1_3_5 contains a back-porting of tools available in release 1_5_0 and can be used with Spring production data.

Release 1_3_5, available on SLC3 only. The following recipe can be used on SLC3 machines, like `lxslc3.cern.ch`:

```
scramv1 project CMSSW CMSSW_1_3_5
cd CMSSW_1_3_5/src
project CMSSW
cvs co -r V01-02-01-01 ElectroWeakAnalysis/ZReco
eval `scramv1 run -csh`
```

```
cd ElectroWeakAnalysis/ZReco/test
```

The following recipe can be used on SLC4, but requires recompiling about 15 packages:

```
scramv1 project CMSSW CMSSW_1_3_4
cd CMSSW_1_3_4/src
project CMSSW
cvs co -r AnalysisTools_1_3_5_prelim2 DataFormats SimGeneral CMS.PhysicsTools ElectroWeakAnaly
cvs update -r V01-02-01-01 ElectroWeakAnalysis/ZReco
eval `scramv1 run -csh`
cd ElectroWeakAnalysis/ZReco/test
```

The default test scripts run on samples of Drell-Yan processes from the Spring07 production.

To run skim tests use:

```
cmsRun testZToMuMuReco.cfg
```

and:

```
cmsRun testZToEEReco.cfg
```

Related documents

- [Analysis Model](#): presentation at Physics/Trigger week, Apr 24 2007
- [Particle Candidates](#): definition of Particle Candidates for a common set of tools.
- [Particle Candidate Utilities](#): a toolkit of utilities and framework modules using Particle Candidates.
- [GenParticleCandidate](#): new format for generator output
- [Monte Carlo truth matching tools](#)
- [Generic isolation module](#)

Review Status

Editor/Reviewer and date	Comments
LucaLista - 25 Jun 2007	Page last edited

Responsible: LucaLista

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This topic: CMSPublic > SWGuideZSkimContent

Topic revision: r26 - 2008-04-18 - CMSUserSupport



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