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Muon Physics Object Offline Guide

Introduction

This page gives a summary of algorithms used to reconstruct muons in CMS, describes collections of muons produced in the processing of data and Monte Carlo samples, and contains links to other useful information on muon reconstruction.

Tutorials

- Muon reconstruction algorithms by I. Bloch, Jan. 2009 (FNAL).
- Analysis of muons in CRAFT data by J. Piedra, Dec. 2008 (CERN).
- Introduction to muons by J. Hollar, Oct. 2008.

General Talks about Algorithms and Identification

- Muon reconstruction and identification by R. Bellan, Jun. 2009 (CERN).

RECO/AOD collections

Data collections available for reconstructed muons are described in SWGuideDataFormatRecoMuon. The full list of products can be found in the following pages:

- RECO collections
- AOD collections

Full definition of the muon-related content in the event record can be found at this link [↗](#).

Algorithms and Software Architecture

The software resides mostly in the RecoMuon [↗](#) and DataFormats/MuonReco [↗](#) repositories in CMSSW.

Standard sequences used in default muon reconstruction (pp collisions)

- Muons in High Level Trigger (HLT)
- Standalone muon reconstruction <--- Workbook section
- Global muon reconstruction <--- Workbook section
- Reconstruction of high-pT muons <--- Workbook section
- Reconstruction of "tracker muons" <--- Workbook section
- Reconstruction of "calo muons" <--- Workbook section
- Muon isolation <--- Workbook section

A short description of each sequence can be found in the muon Workbook by clicking here or on the "Workbook section" links above; in some cases, when more details are available in TWiki, they can be viewed by clicking on the sequence name. Direct link to the definition of standard muon sequences in CMSSW is here [↗](#).

Standard sequences used in cosmic muon reconstruction (CRUZET, CRAFT, and dedicated cosmic runs, as well as corresponding MC samples)

- Cosmic muon reconstruction

Baseline muon selections recommended by the Muon POG

- Description of selections in SWGuideMuonId
- Links to reference efficiencies for baseline muon selections and isolation algorithms

Algorithms for measuring muon reconstruction performance from data

(These algorithms are not run as a part of standard muon reconstruction)

- Efficiency measurements:
 - ◆ Tag-and-probe package
- Muon-momentum scale calibration:
 - ◆ MuSclFit package
 - ◆ SIDRA package

Analysis and Validation

- MC Truth muon association: detailed tools used for validation, software development, ...
- Analysis-level association tools for matching reconstructed muons to trigger info, MC or other offline objects.
- Standard tool for inclusive plots of muon variables and for data/mc comparisons.
- Muon POG release validation:
 - ◆ Instructions on how to run Muon RECO validation are at this link. [NEW](#)
 - ◆ Instructions on how to run the Muon HLT validation are at this link. [NEW](#)
 - ◆ Part of the validation is done using analyzers under the DQMOffline branch. Description of the relevant plots can be found at this link. [NEW](#)
 - ◆ Release-validation plots for muon reconstruction (standalone, global and high- p_T muons, muon isolation, algorithmic HLT efficiencies, etc.) are at this link [?](#).
 - ◆ (OBSOLETE) Release-validation plots for muon identification (tracker muons) are at this link [?](#).
 - ◆ (OBSOLETE) Release-validation plots for muon HLT are at this link [?](#).

Documents

- **CMS AN 2008/097**: *G. Abbiendi et al., "Muon Reconstruction in the CMS Detector"*. Detailed description of reconstruction algorithms for standalone, global and tracker muons, and of their performance.
- **CMS AN 2008/098**: *M. Mulders et al., "Muon Identification in CMS"*. Description of recommended selection criteria for global muons and tracker muons.
- **CMS AN 2007/038**: *M. Chen et al., "Search for New High-Mass Resonances Decaying to Muon Pairs in the CMS Experiment"*. Section 3.3 contains a review of reconstruction algorithms for high- p_T muons and their performance as of Spring 2008.
- **CMS Note 2008/001**: *C. Liu and N. Neumeister, "Reconstruction of Cosmic and Beam-Halo Muons"*. (Also published as *Eur. Phys. J. C 56 (2008) 449* [?](#).) Description of dedicated cosmic-muon reconstruction algorithm. Written in Sep. 2007, so certain parts may be outdated.

Related Topics

- Local muon reconstruction. Muon DPG pages: reconstruction of hits of segments, calibration, alignment, etc.
- Muon alignment. Muon alignment (and misalignment) page.
- Fast simulation. Detailed description of fast simulation, including that of the muons.
- Physics Analysis Tools. Home of upper-level analysis framework.
- High-mass dimuon studies. Page of Exotica sub-group studying high-mass dimuons (high-pT muons).

Contacts

- **Group home page:** MuonPOG
- **Muon POG conveners:** Giovanni Abbiendi and Daniele Trocino
- **Hypernews forum:** <https://hypernews.cern.ch/HyperNews/CMS/get/muon.html>
(hn-cms-muon@cernNOSPAMPLEASE.ch)

Review status

Reviewer/Editor and Date (copy from screen)	Comments
KatiLassilaPerini - 09 Mar 2007	created template page
NicolaAmapane - 12 Mar 2007	added group-specific content
SlavaValuev - Feb 2009	Overhaul

Responsible: DmytroKovalskyi

Last reviewed by: SlavaValuev - 04 Mar 2009