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The Compact Muon Solenoid Experiment

Analysis Note

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Muon Reconstruction in the CMS Detector

G. Abbiendi[1], N. Adam[16], J. Alcaraz[2], N. Amapane[3], E. Antillon[4], R. Bellan[5], I. Belotelov[6], I. Bloch[7]
C. Campagnari[8], T. Cox[9], A. Everett[4], A. Grelli[4], J. Goh[10], V. Halyo[16], A. Hunt[16], E. James[7],
P. Kalavase[8], S.C. Kao[11], M. Konecki[12], D. Kovalskyi[8], V. Krutelyov[8], C. Liu [4], P. Martinez [17] D. Miller[4]
M. Mulders[5], N. Neumeister [4], D. Pagano[4], J. Pivarski[14], J. Ribnik[8], S. Stoynev[13], P. Traczyk[5],
D. Trocino[3], J.R. Vlimant[8], R. Wilkinson[15]

Abstract

The reconstruction of muons in CMS combining tracking and calorimeter information is described. The high-level muon physics objects are reconstructed in a multi-faceted way, with the final collection being comprised of three different muon types, Stand-alone, Global and Tracker muons. The reconstruction in the muon spectrometer starts with the reconstruction of hit positions in the DT, CSC and RPC subsystems. Hits within each DT and CSC chamber are then matched to form “segments” (track stubs). The segments are collected and matched to generate seeds that are used as a starting point for the actual track fit of DT, CSC and RPC hits. The result is a reconstructed track in the muon spectrometer, and is called “stand-alone muon”. Stand-alone muon tracks are then matched with tracker tracks to generate “global muon” tracks, featuring the full CMS resolution. “Tracker muons” are muon objects reconstructed with an algorithm that starts from a silicon tracker track and looks for compatible segments in the muon chambers. A unique collection of muon objects is assembled from the stand-alone, global, and tracker muon collections. Muon isolation quantities using calorimeter information and tracker tracks for muons defined at the three different levels are combined into the muon objects.

[1] Università di Bologna e Sezione dell’INFN, Bologna, Italy

[2] CIEMAT, Madrid, Spain

[3] Università di Torino e Sezione dell’INFN, Torino, Italy

[4] Purdue University, West Lafayette, Indiana, USA

[5] CERN,Geneva, Switzerland

[6] Joint Institute for Nuclear Research, Dubna, Russia

[7] Fermi National Accelerator Laboratory, Batavia, Illinois, USA

[8] University of California, Santa Barbara, Santa Barbara, California, USA

[9] University of California, Davis, Davis, California, USA

[10] Sungkyunkwan University, Suwon, Korea

[11] University of California, Riverside, Riverside, California, USA

[12] Institute of Experimental Physics, Warsaw, Poland

[13] Northwestern University, Evanston, Illinois, USA

[14] Texas A&M University, College Station, Texas, USA

[15] California Institute of Technology, Pasadena, California, USA

[16] Princeton University, Princeton, New Jersey, USA

[17] Universidad de Cantabria, Santander, Spain

8 Conclusions

The ability to identify and reconstruct muons with high efficiency over the whole kinematic range of the LHC is the key to the success of the CMS experiment. This requires algorithms that are robust and flexible and use all the available detector information over the full geometrical acceptance of the CMS detector. We have shown that the current algorithims fulfill all the necessary requirements for the reconstruction of single muons with full detector simulation. Muons are identified and reconstructed with efficiencies of close to 99% with clearly defined understood efficiency losses due to the CMS detector geometry. Muons are reconstructed in three categories

- Stand-Alone muons using just muon detector information and the interaction point
- Global muons which match stand-alone muons with silicon tracker tracks.
- Tracker muons which match silicon tracker tracks with calorimeter energy deposits and muon system hits

The final output from the algorithms is a muon physics object together with a compatibility value indicating the probabilty of the track being a muon. These algorithms satisfy all of the requirements for robust high efficiency reconstruction. These algorithms are the foundation for real data taking and analysis and can be tuned for the more complex environments of real events and actual detector inefficiencies.

Acknowledgements

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