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Alignment of the CMS muon system with cosmic-ray and beam-halo muons

CMS Collaboration

ABSTRACT: The CMS muon system has been aligned using cosmic-ray muons collected in 2008 and beam-halo muons from the 2008 LHC circulating beam tests. After alignment, the resolution of the most sensitive coordinate is 80 microns for the relative positions of superlayers in the same barrel chamber and 270 microns for the relative positions of endcap chambers in the same ring structure. The resolution on the position of the central barrel chambers relative to the tracker is comprised between two extreme estimates, 200 and 700 microns, provided by two complementary studies. With minor modifications, the alignment procedures can be applied using muons from LHC collisions, leading to additional significant improvements.

KEYWORDS: Muon spectrometers; Large detector systems for particle and astroparticle physics

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The overlap of CSC rings permits an analytic solution to its alignment. Non-Gaussianity in the physics of track propagation through the steel yoke implies a non-linear extension to the general alignment method.

Techniques which will be useful for re-aligning the muon system with early LHC data have been tested. The favorable distribution of muons from collisions will broaden the applicability of these methods and open new opportunities for cross-checks and diagnostics, which ultimately will lead to a better-understood momentum resolution for high-momentum muons and increased discovery reach for high-energy processes.

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2010 JINST 5 T03020

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2010 JINST 5 T03020