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A Novel Assembly Procedure of GE1/1 Detectors for CMS High Luminosity Phase of the LHC

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Abstract

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A Novel Assembly Procedure of GE1/1 Detectors for CMS High Luminosity Phase of the LHC

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Abstract. A CMS muon group is investigating the possibility of enhancing muon tracking and triggering capabilities in the region $1.6 < |\eta| < 2.18$ of the CMS experiment at the LHC by instrumenting the end-cap muon system with large-area tipple GEM detectors. These GE1/1 detectors are considered as an important technology for High-Luminosity phase of LHC and contain a triple-GEM with a 3/1/2/1 mm drift/transfer-1/transfer-2/induction field gap configuration and the active readout area of $0.345/0.409\text{m}^2$ for the short/long chambers. We describe a novel assembly procedure of such detectors at LHC.

Keywords: CMS, GEM

1 Introduction

The CMS Collaboration has proposed several muon system upgrades during the future High Luminosity phase of LHC in order to maintain its high level of performance. The CMS muon system [?] is designed to provide robust, redundant and fast identification of the muons traversing the system, in addition to trigger capabilities and momentum measurement. CMS-Muon Collaboration has therefore proposed to install two layers of triple-GEM [?] chambers known as GE1/1 and GE2/1 in the endcap regions $1.6 < |\eta| < 2.18$ and $1.55 < |\eta| < 2.45$ respectively. Integration of these new detectors with existing muon system can highly improve the muon trigger momentum resolution.

Fig. 1: (a) Basic sketch of GEM assembly and its components (b) Foil stretching mechanism.

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2 The full size prototype construction

The GE1/1 prototype has a tripzoidal shape with active area of approximately $\sim 220\text{cm}$ and $\sim 420\text{cm}$ on narrower and wider side and length of about $\sim 950\text{cm}$. Pre-assembly of such detectors involves optical and electrical tests to determine geometric defects and leakage current values. The variation in the leakage current should not exceed 30 nA and 50 nA corresponding to the humidity values of 30% and 45% respectively when a potential of 550V is applied across it using a testing Megger. This test can lead the observation of initial discharges which can be heard or seen at the beginning but eventually should disappear. The detector is then built by piling up various components as shown in the Figure ??(a) over a precision machined reference table called as assembly table. To assemble a single GE1/1 detector with gap configuration of 3/1/2/1, firstly a GEM stack is formed by putting alignment pins positioned on the Plexiglass board with 3mm side spacers inserted over these guidening pins which are lying on the top of the Plexiglass board before putting the first GEM foil. Similarly a stack of three foils is formed with respective spacing. The Stack is then removed and placed over the drift board and on the other side is closed using a readout board. The whole mechanism involved is shown in ??.

Fig. 2: (a) Placement of side spacers over the guidening pins to form the fine trapezium (b) Cleaning of the GEM foil using adhesive roller (c) Leakage current check using Megger (d) Placement of the GEM foils on assembly table (e) Placement of stretching nuts for foil stretching (f) Removing the dead area from the GEM stack (g) Placement of triple-GEM stack over the drift board and (h) Final GE1/1 detector.

3 Conclusion

The GEM GE1/1 assembly for the CMS has been described and such detector's would be installed in the CMS during the phase II (LS2) upgrade scheduled to be in 2018/2019. The detectors will provide fast triggering, precise tracking, will improve overall muon trigger and also can sustain the high radiation environment for long-term.

References

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