CMS HCAL Phase-I & II Upgrade Test Beam

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Test Beam Scope

• Main goal: test of pre-production front-end electronics for CMS HCAL Phase-I upgrade
  • Production front-end for Hadronic Endcap (HE) Phase-I upgrade, scheduled for next YETS
  • Pre-production front-end for Hadronic Barrel (HB) Phase-I upgrade, scheduled for LS2

• Secondary goal: test of plastic scintillator candidates for CMS HCAL Phase-II upgrade
  • SiPM-on-tile configuration test for High-Granularity Calorimeter – Backend Hadronic (HGC-BH) section
  • New plastic scintillator materials for both HGC-BH and HB Phase-II upgrade (scheduled for LS3)
Experimental Setup

Readout Module

HB-HE Rotating Table
Devices Under Test

- HE front-end electronics
  - Production Calibration Unit (CU)
  - Production Readout Module (RM)
  - Production-2 Clock-and-Control Module (ngCCM)

- HB front-end electronics
  - Prototype CU
  - Prototype RM

- Legacy front-end electronics available for comparison

Charge Integrator & Encoder (QIE) cards
Production HE; Prototype HB
HCAL Phase-II Activities

- Irradiated plastic scintillator
  - Measure uniformity of light yield vs. hit position
- SiPM-on-tile configuration
  - Test new method to collect scintillation light (replaces wavelength-shifting fiber)
- New plastic scintillators
  - Evaluate materials with improved radiation tolerance
**Beam Types & Plans**

- **Pions: 30-300GeV**
  - (P-I) Study energy resolution, timing, and shower development
  - (P-I) Measure non-linearity of SiPM devices w/ comparison to legacy system (hybrid photodiodes – HPDs)
  - (P-II) Study SiPM-on-tile configuration

- **Muons: 150GeV**
  - (P-I) Verify detector mapping
  - (P-I) Perform MIP calibration, study pulse shape
  - (P-II) Study light yield of plastic scintillator candidates, signal timing, light-collection efficiency versus MIP position
  - (P-II) Study SiPM-on-tile configuration