LHC CMS Detector Upgrade Project

CMS HCAL Phase-I & II Upgrade Test Beam

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Executive Summary

- Primary goal: test of FE electronics and photosensors for CMS HCAL Phase-I upgrade
  - Pion energy scans; 30-50-80-100-150-200-250-300GeV; about 100kevents/run; multiple FE configurations; selected η-ϕ towers served by SiPM photosensors (Phase-I upgrade) and HPD photosensors (legacy system)
  - Electron energy scans; 30-50-80-120-200GeV; about 2-4kevents/run; selected η-ϕ tower served by SiPM
  - Muon runs for MIP calibration
- Secondary goal: test of plastic scintillators for CMS HCAL Phase-II upgrade
  - 6.7Mevents; muons from 200GeV pion beam
    - About 50% more than in 2015 test beam
  - Muons and pions on SiPM-on-tile setup: O(10M)events

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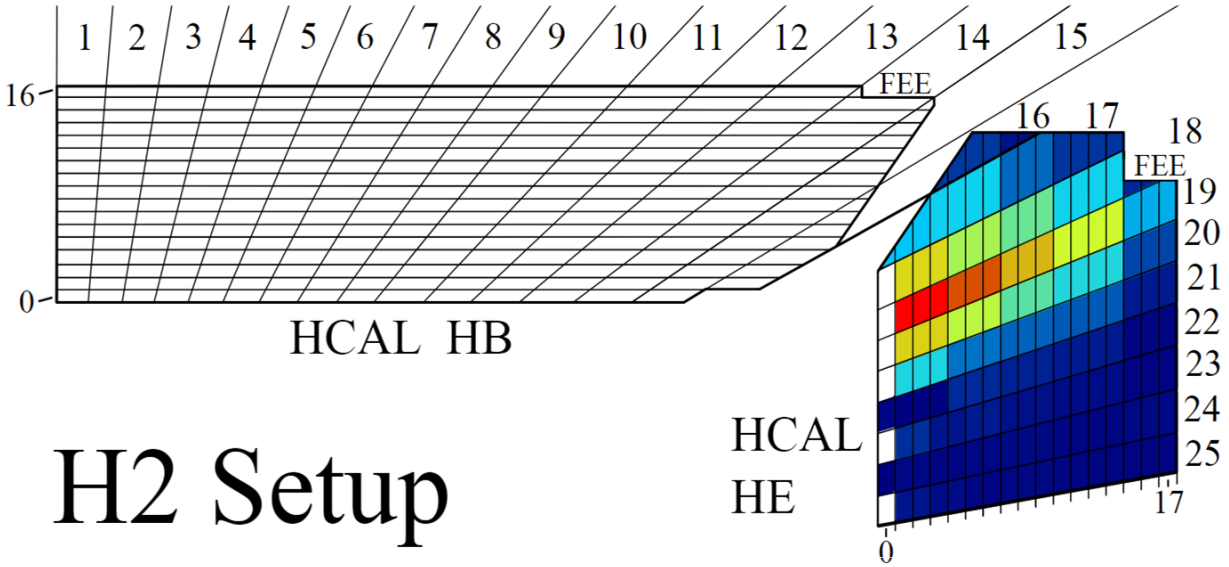
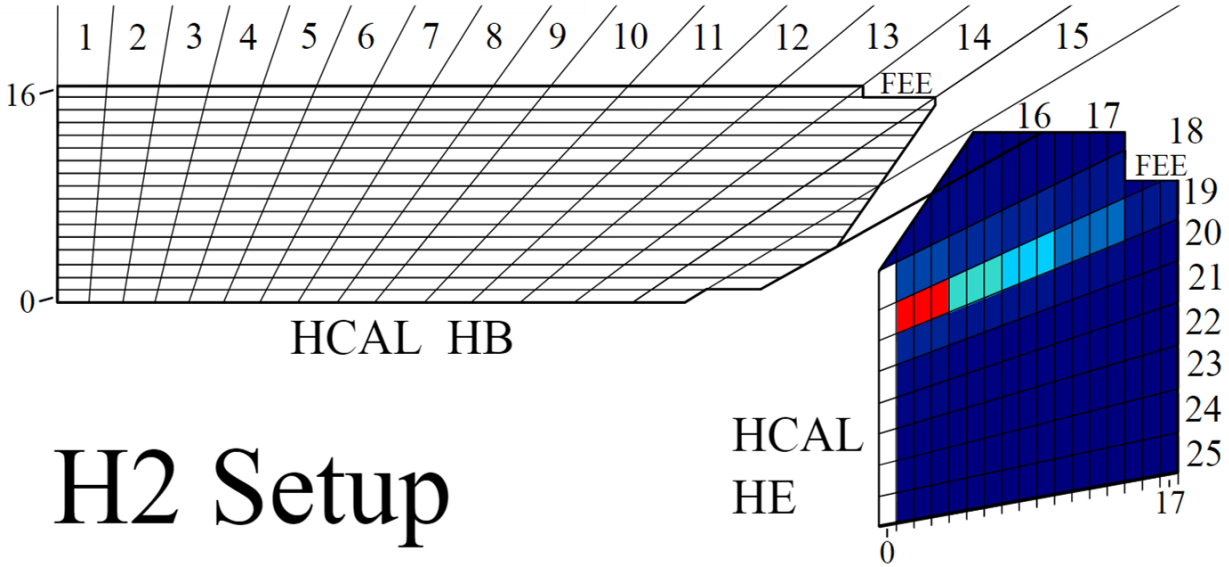
A quick peek at the data



50GeV Pions

80GeV Electrons

H2 Setup



H2 Setup

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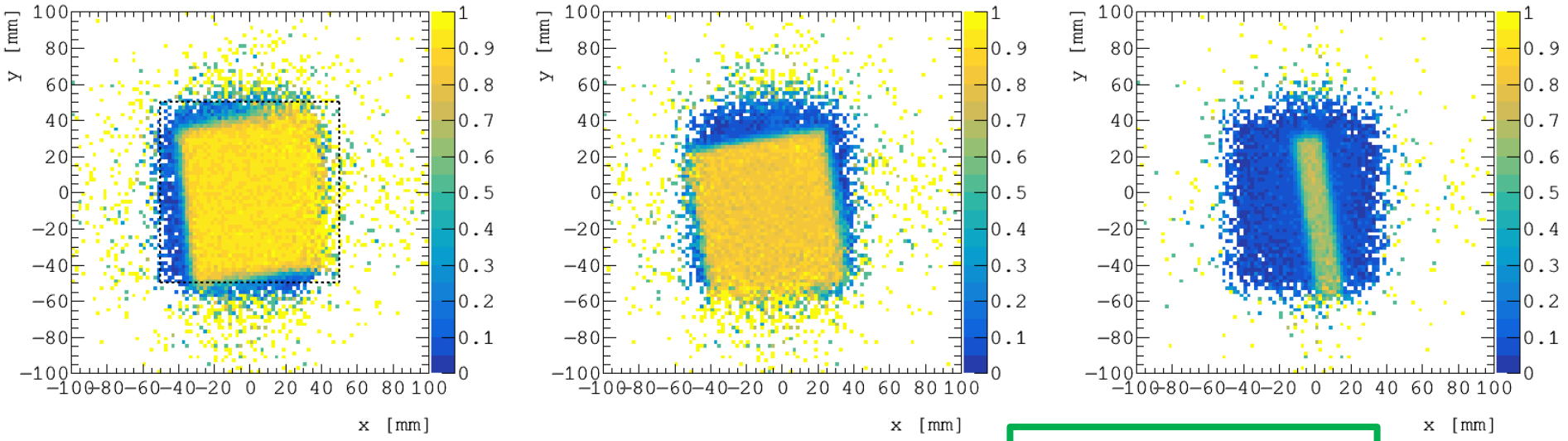
Animations:
http://cmskam06.cern.ch/tb2017/detector_view/

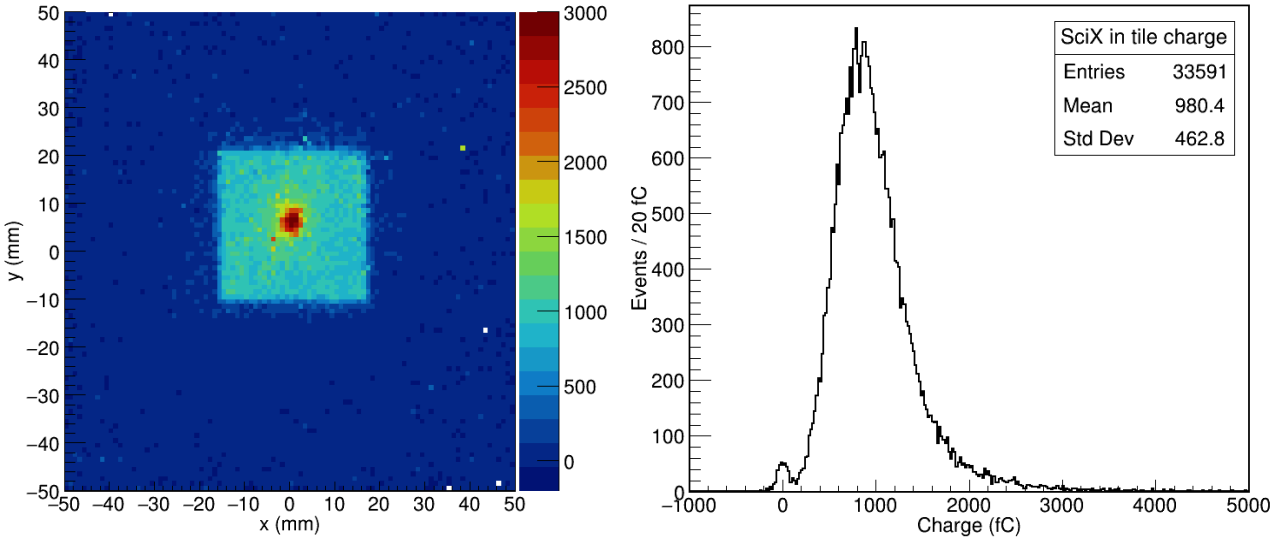
Phase-II materials



200GeV Muons

- Efficiency vs. hit position
  - Fraction of events with integrated charge above pedestal
- Measurement of interest: map of efficiency and light yield vs. position
  - From left to right: EJ-200 irradiated at Goddard Space Flight Center (0.3Mrad); SCSN-81 (current CMS HCAL scintillator) irradiated next to LHC (2Mrad), square and rectangular tiles

More Phase-II materials



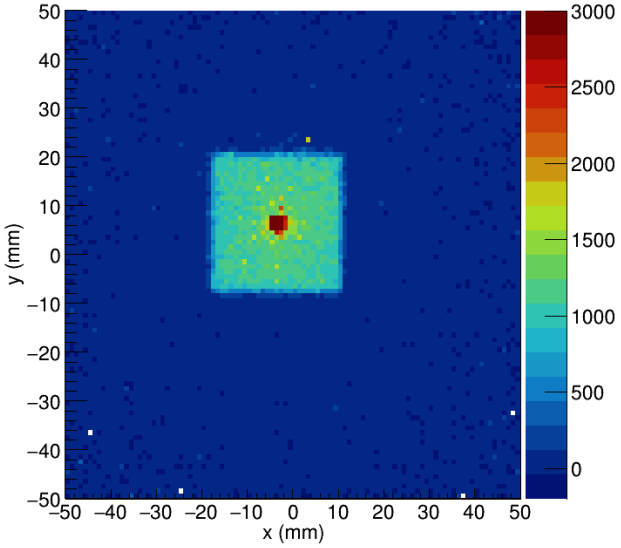
150GeV Muons

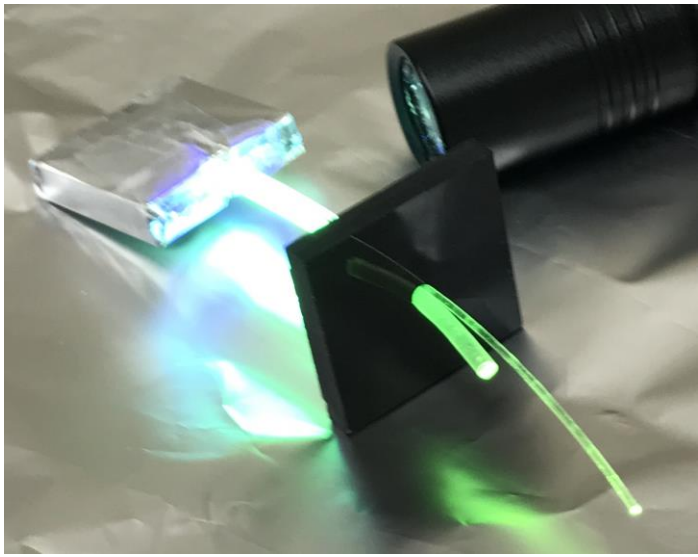
Scintillator-X
3x3cm^2 sample
SiPM-on-tile

B. Bilki
University of Iowa

Three 2.5x2.5x0.5cm^3 blue scintillator tiles

Silicon-based WLS fiber: 2.5mm OD 1mm ID capillary with 3HF-doped silicon gel core





Summary

- Start of test beam unusually smooth
  - One board broke on day-1; cooked up working system immediately (offering lower event rate), installed replacement within day-4 (back to full speed)
- Completed plan of measurements
  - Aggressively planned for more data, more configuration variants, but happy with collected sample
- Happy to acknowledge the support we received
  - Thanks to Henric, Nikos and Yiota, Laza, Beam Inst. Group (thanks for the wire chambers!), David J., Alexandre, the machine department