Role in the CMS detector

- The endcaps of the CMS detector are instrumented with Cathode Strip Chambers (CSCs).
- These detectors identify muons emitted in the forward and backward directions \((0.9 < |\eta| < 2.4)\).
- Muons are signatures of Standard Model (e.g. \(H \rightarrow ZZ \rightarrow \mu^+\mu^-\mu^+\mu^-\)), and New Physics processes.
- The most important ODMB functions are handled by a Field-Programmable Gate Array (FPGA).
- The rest of the board is dedicated to clock distribution, voltage (2.5V, 3.3V, 5V) and standard (LVDS, TTL) translation for the signals that are sent out, and emergency logic in case the FPGA fails.

Muon endcap upgrade

- ME1/1 chamber is critical for online momentum resolution, but is overwhelmed with background.
- During the 2013-2014 shutdown, ME1/1 electronics will be upgraded with more powerful boards.
- Old boards moved to ME4/2.

Data Acquisition upgrade

- The new ME1/1 chamber will have 72 Optical DAQ Mother Boards (ODMB) that ship the data to CMS computing, and control some of the front end boards.
- New optical fiber is faster and more robust than previous copper connection.

Electrical design of the 12-layer Printed Circuit Board (PCB)

- System testing. Example: voltage read from ADC in LVMB (applied 8.00V)
  \[
  V_{ADC} = 10V \times \frac{110011001010}{111111111111} = 10V \times \frac{0xCCA}{0xFFF} = 8.00V
  \]

Firmware development (pictured, flip-flop with asynchronous preset)

Work at UCSB

- We talk to everyone!
- Previous copper connection

Crate controller: connected to PC through fiber

Linux machine: web server to VME

Copper

VME (control)

CCB (clock)

DDU (data)

TMB (trigger)

LVMB (low voltage control)

DCFEBs (data)

DCFEBs (TIC)

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The board

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