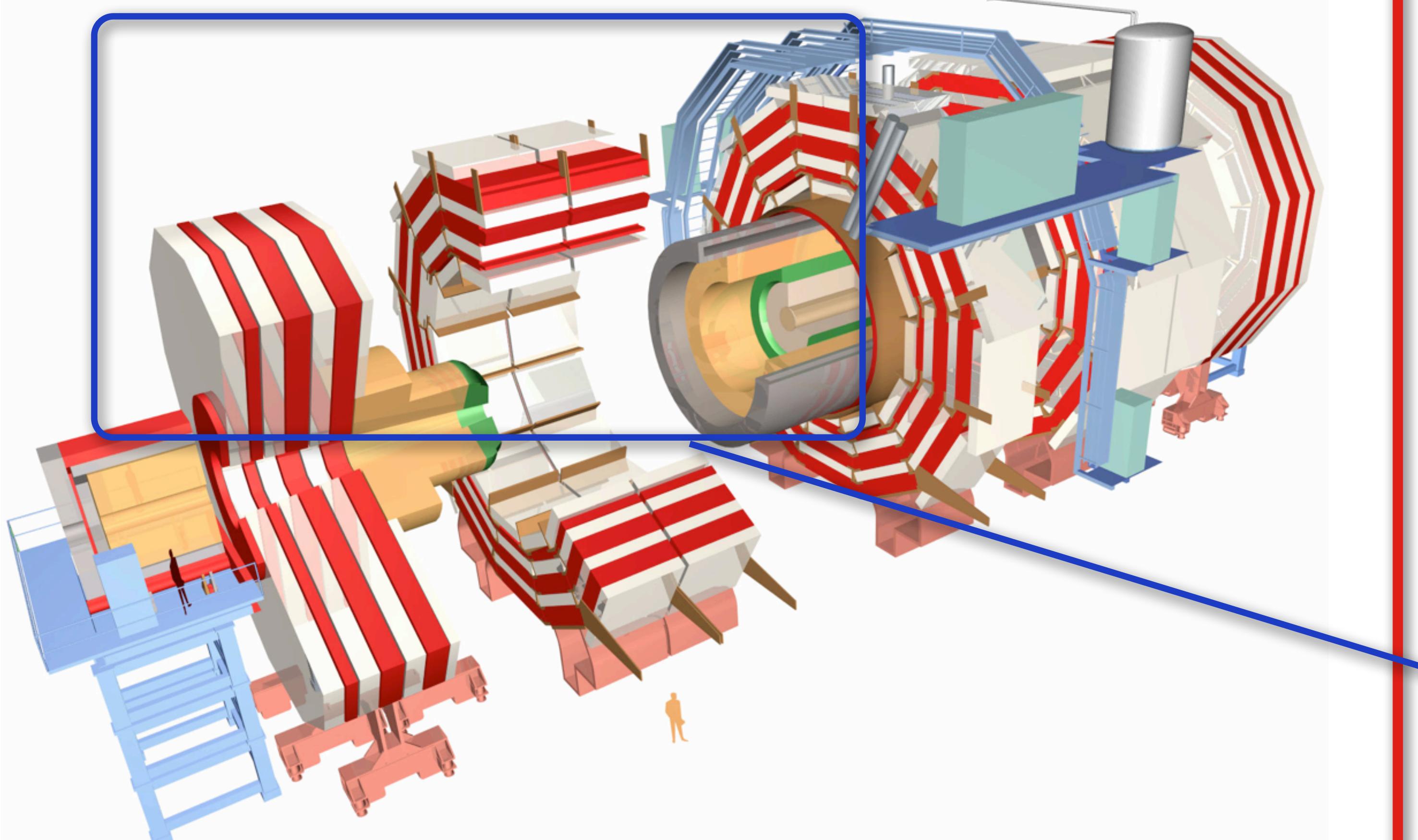
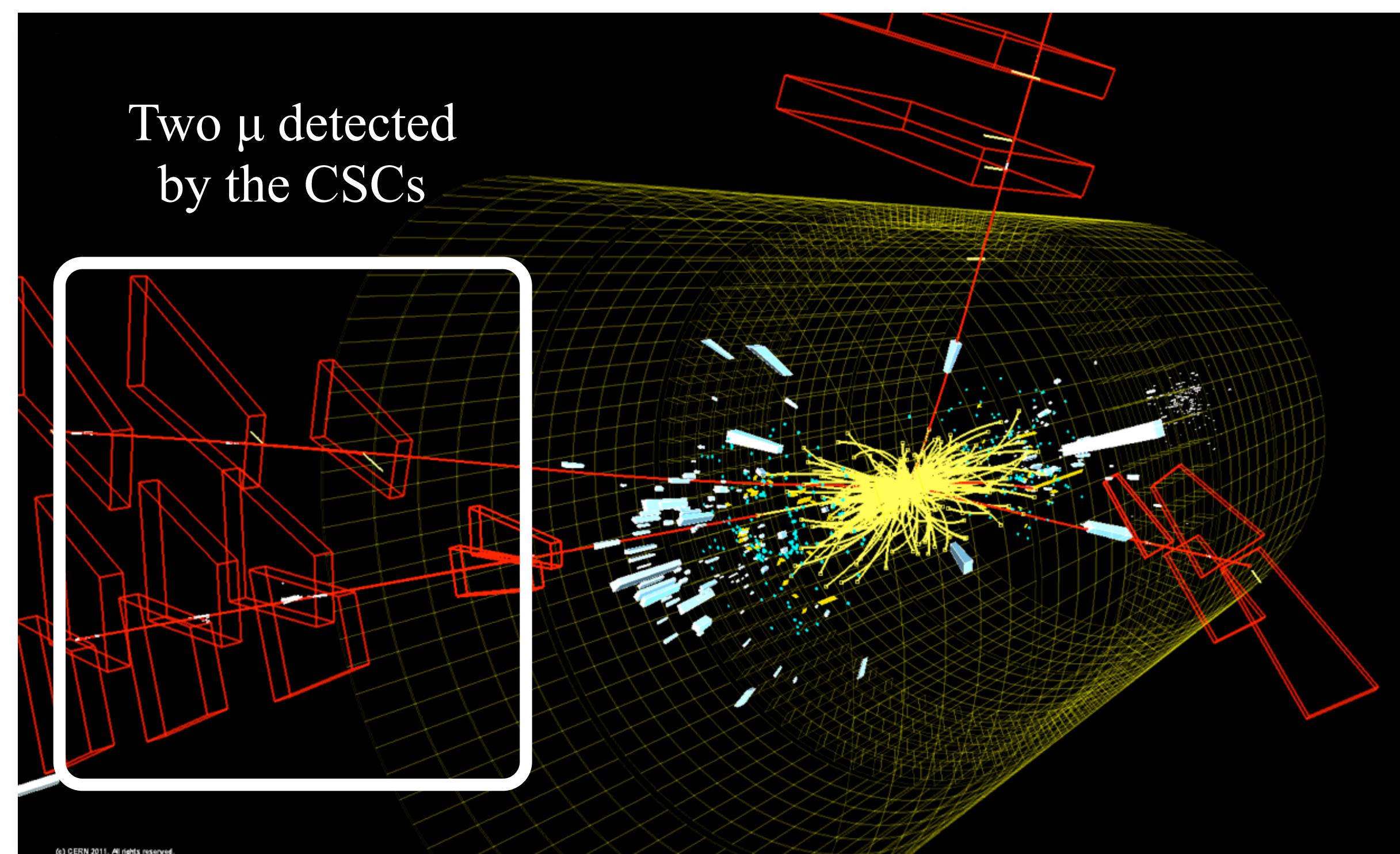


ODMB : Upgrade of the DAQ MotherBoard for the CMS Muon Endcap Detector



UC Santa Barbara, Dept. of Physics, High Energy Experimental Group

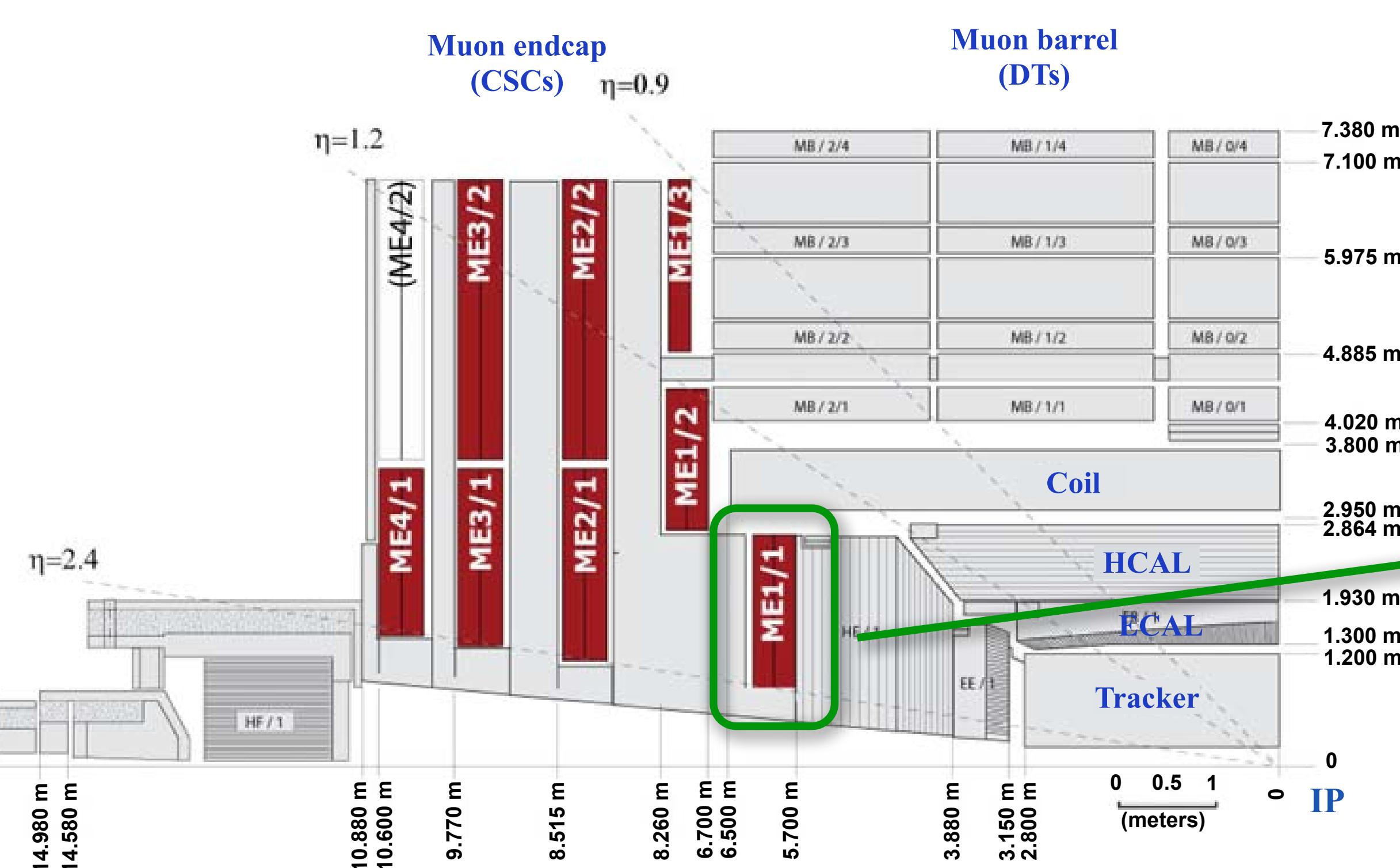
Role in the CMS detector



- 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. $H \rightarrow ZZ \rightarrow \mu^+\mu^-\mu^+\mu^-$, pictured) and **New Physics processes**.

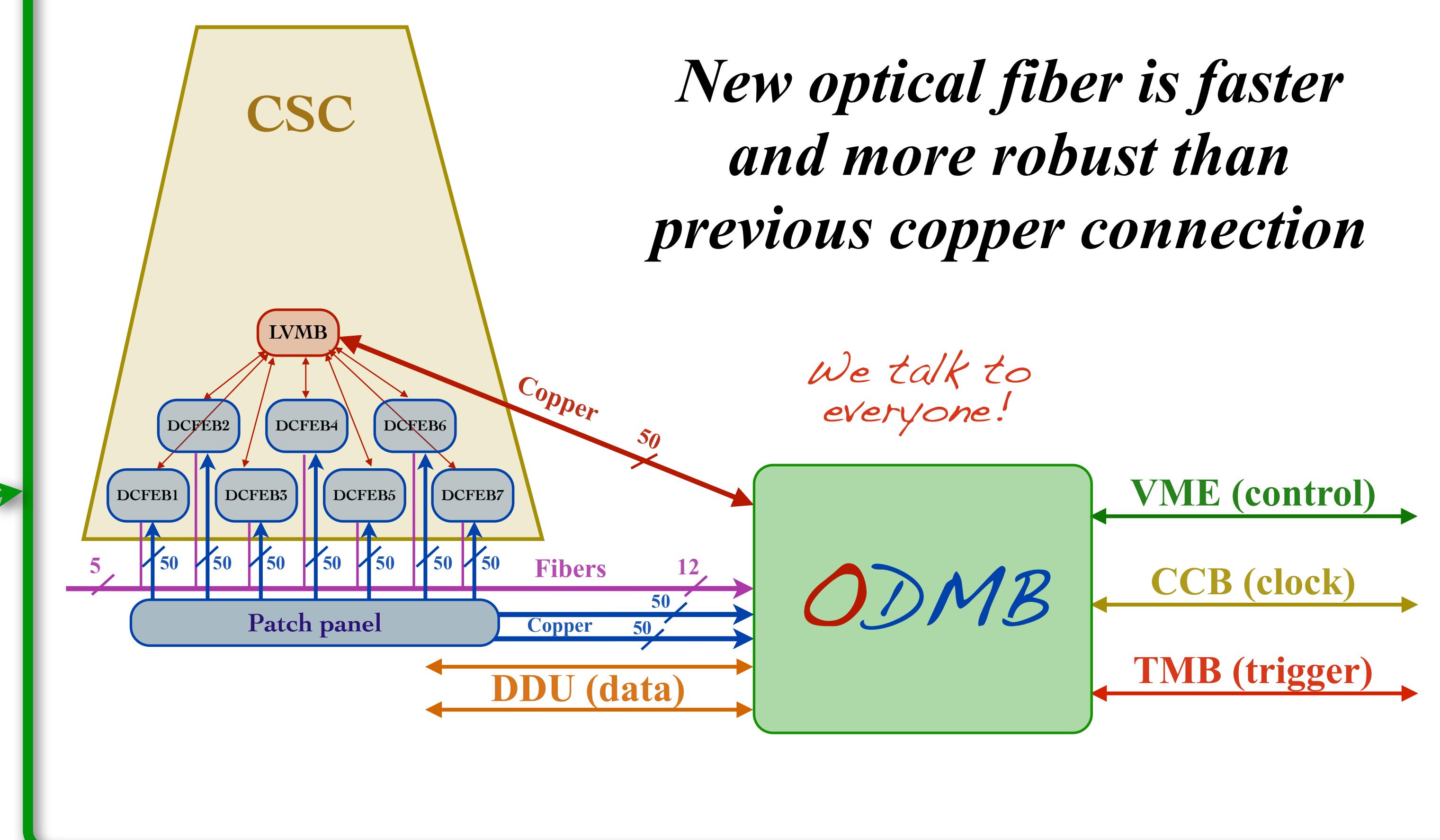
Muon endcap upgrade

- 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.



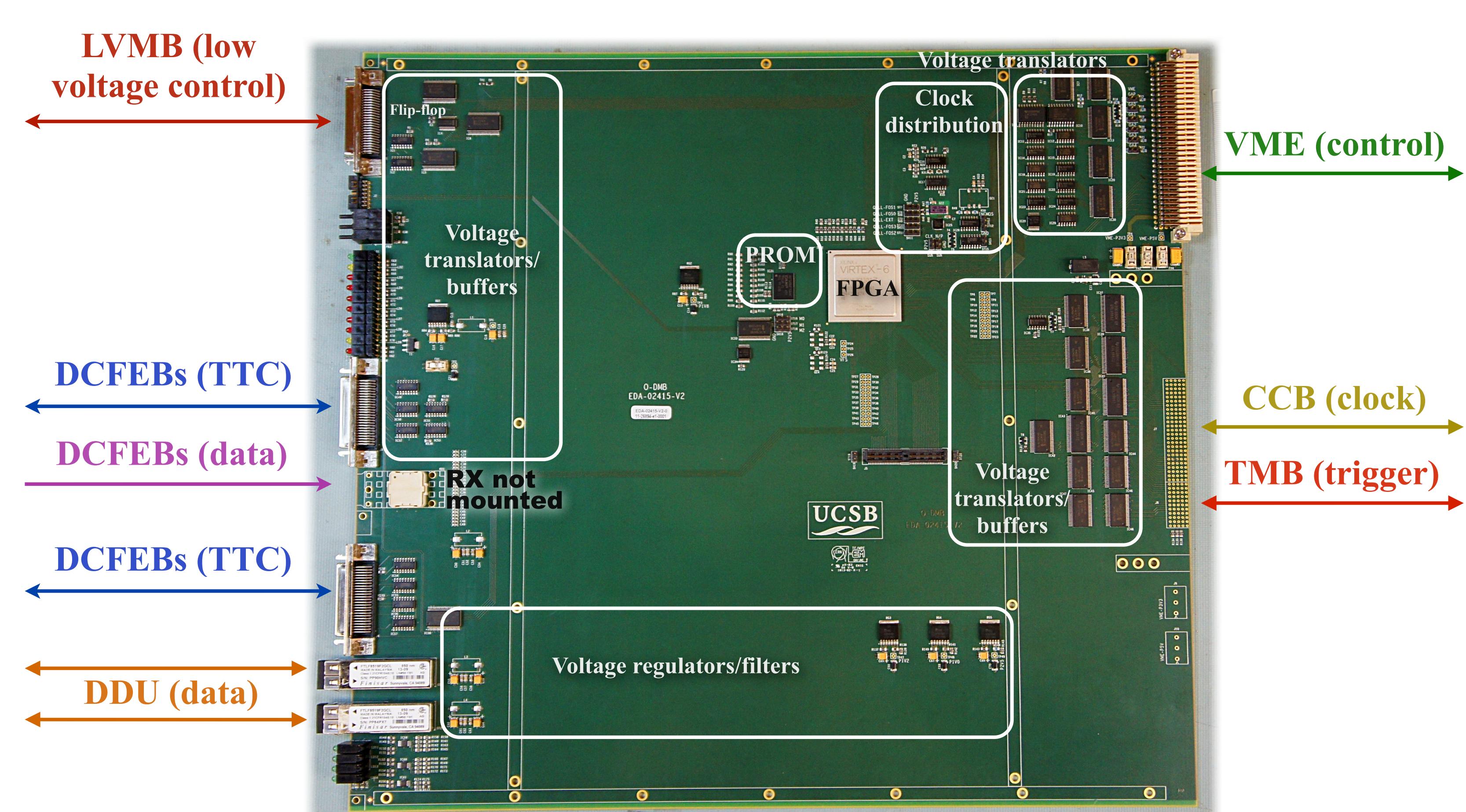
Data Acquisition upgrade

- The new ME1/1 chamber will have **72 Optical DAQ MotherBoards (ODMB)** that **ship the data to CMS computing, and control some of the front end boards**.

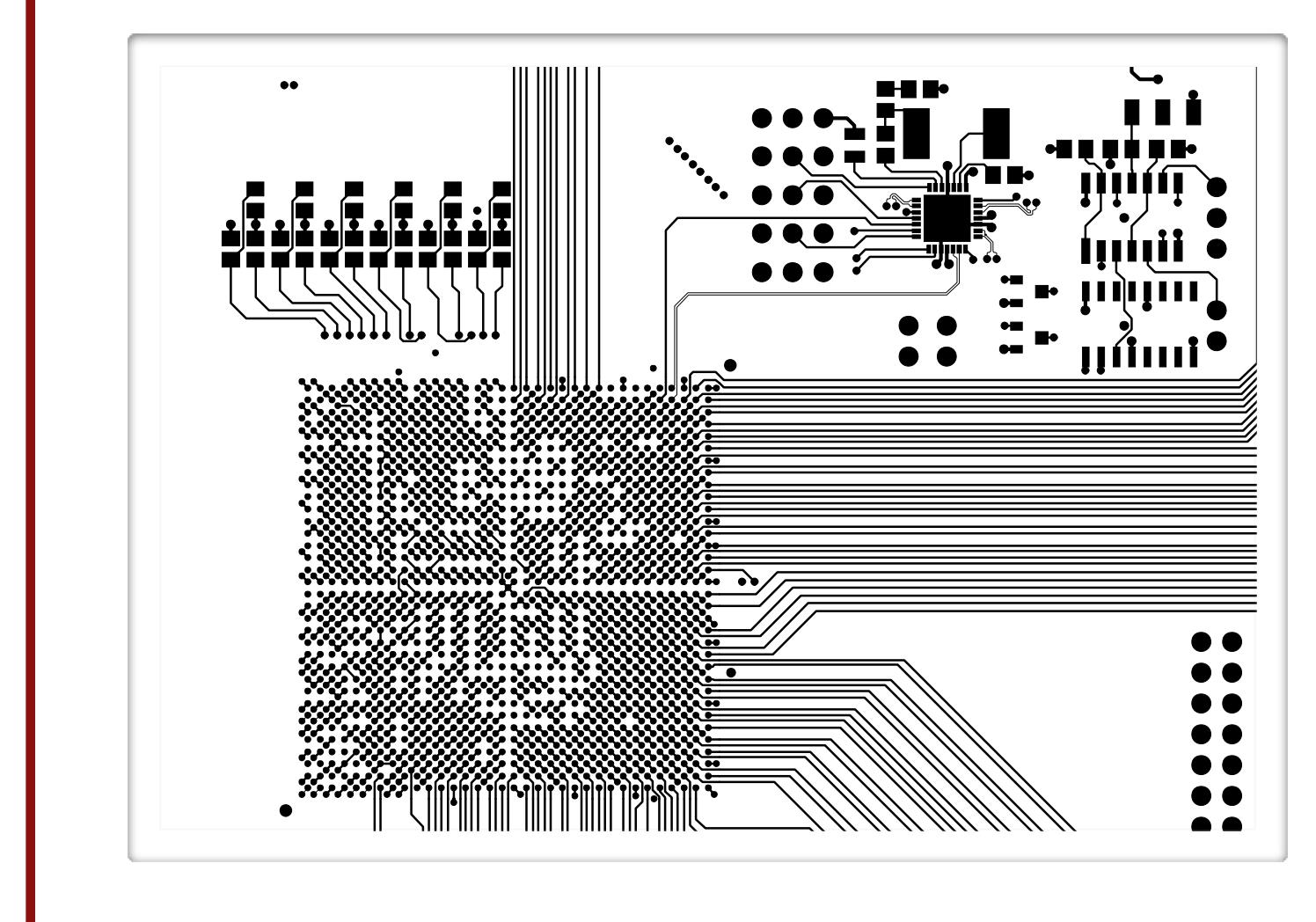


The board

- 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.



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

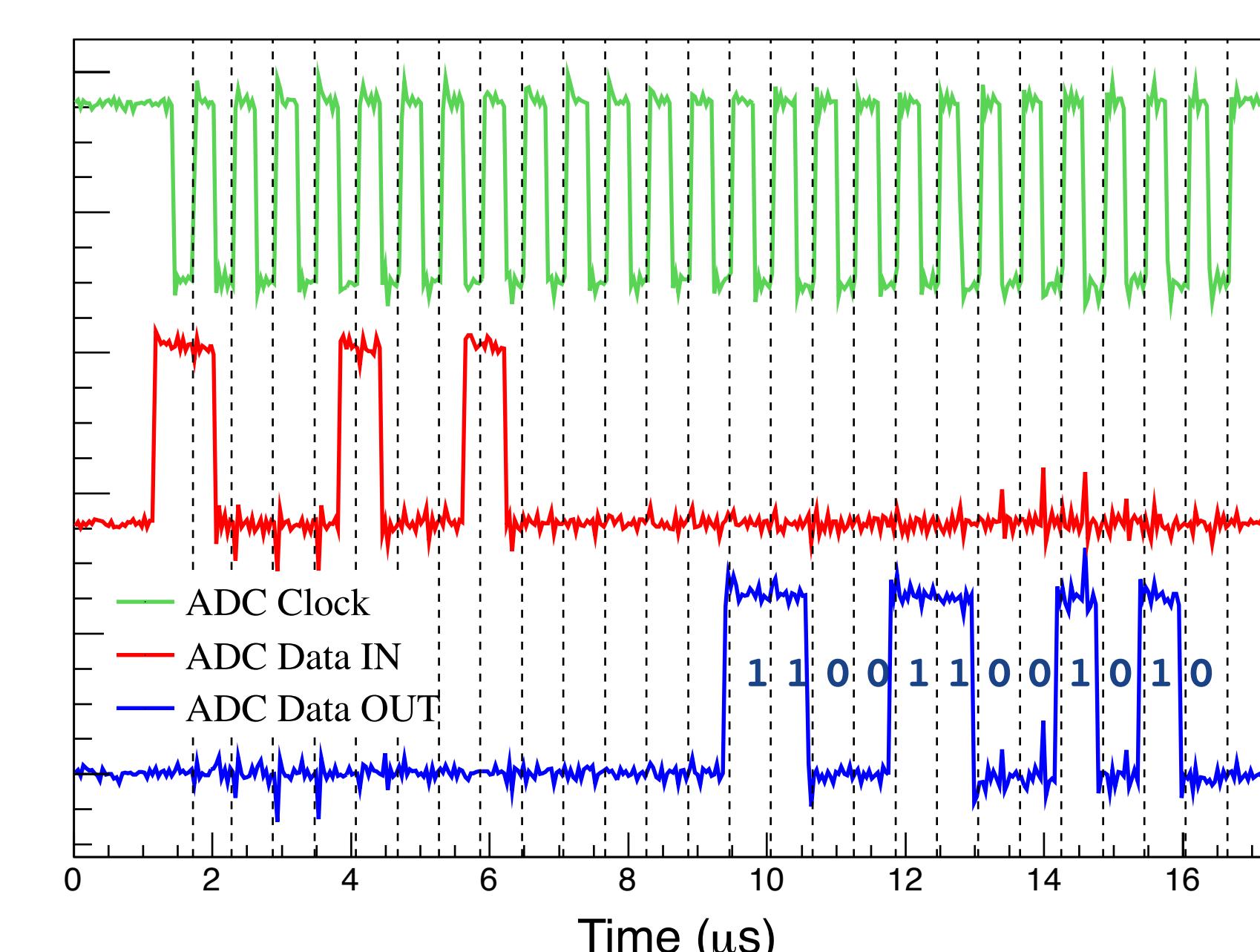


- Firmware development** (pictured, flip-flop with asynchronous preset)

Work at UCSB

- System testing.** Example: voltage read from ADC in LVMB (applied 8.00V)

$$V_{ADC} = 10V \times \frac{110011001010}{111111111111} = 10V \times \frac{0xCCA}{0xFFFF} = 8.00V$$



```
if (PRE='1') then
  Q <= '1';
else
  if (C='1' and C'event) then
    Q <= D;
  end if;
end if;
```

