Fermilab

U.S. DEPARTMENT OF ENERGY | Office of Science

Report on Working Group # 2

The MU2E detector: calorimeter

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MUSE Scientific Board meeting

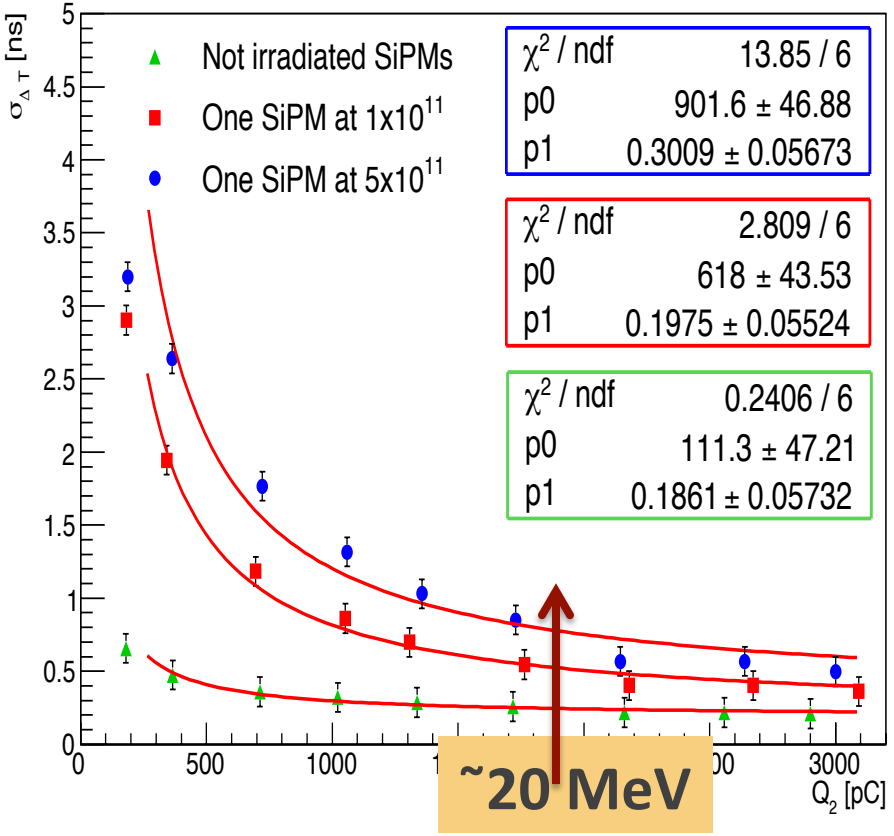
20-Dec-2019

Mu2e

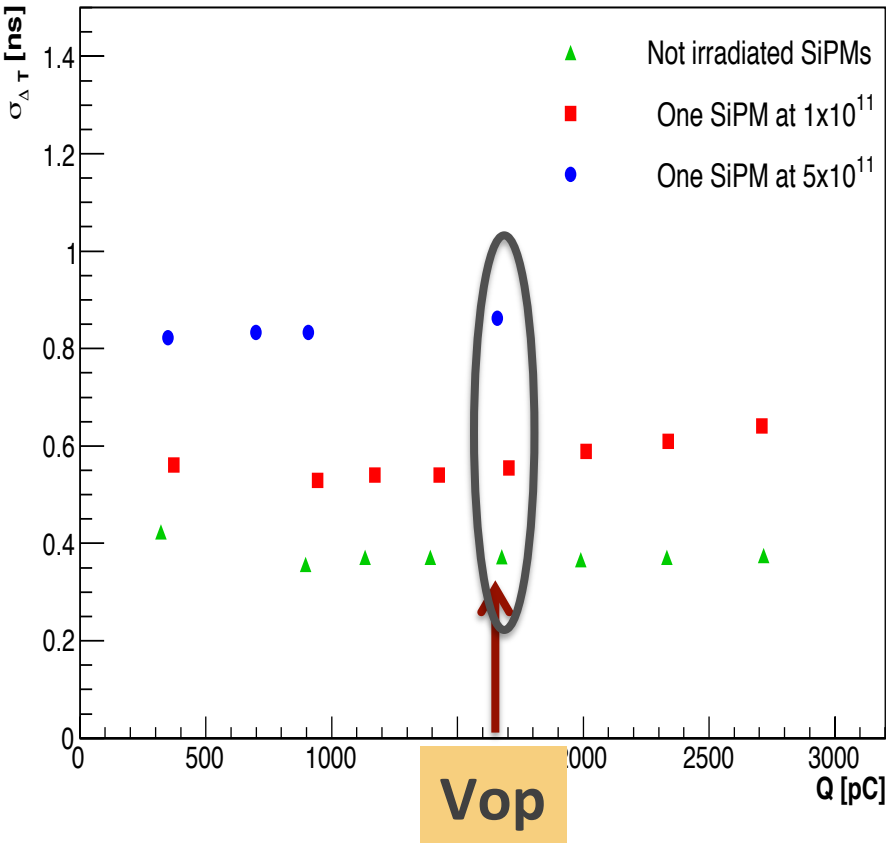
MUSE

Summary of “n” SiPM tests with Laser

Time resolution vs Pulse Height



Time resolution vs Vbias



- First estimate is that one single sensor will get around 800 ps resolution at 5x10^{11} n/cm2 for an energy deposit of O(30 MeV).
- Factor of sqrt(2) achieved using two sensors/crystal → **560 ps , close to requirement**

Progress N.1: FEE CRR

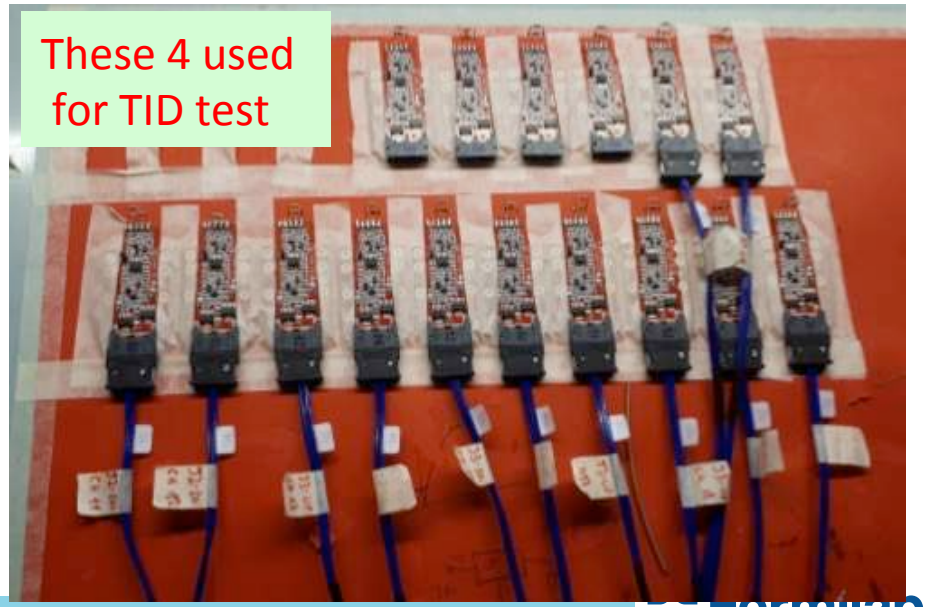
- CRR for rad-hard FEE and FEE-Mezzanine cables done Nov 18 2019
- 20 FEE prototypes + 5 MB prototypes and 7 x 4 FEE-MB cables in hand
- Integrated test done last week with 4 of these prototypes up to a TID of 100 krad → Amplifier, HV-regulator and DAC (to set HV) OK

  → ADC (read HV, T and Id) show drifts on readout. Recovered with calibration

  → unexpected loss of 1 MOSFET for the two boards with HV OFF

➔ Requires another round of irradiation after having selected the DAC/ADC lot

➔ B-Field test completed successfully



Progress N. 2: FEE tenders

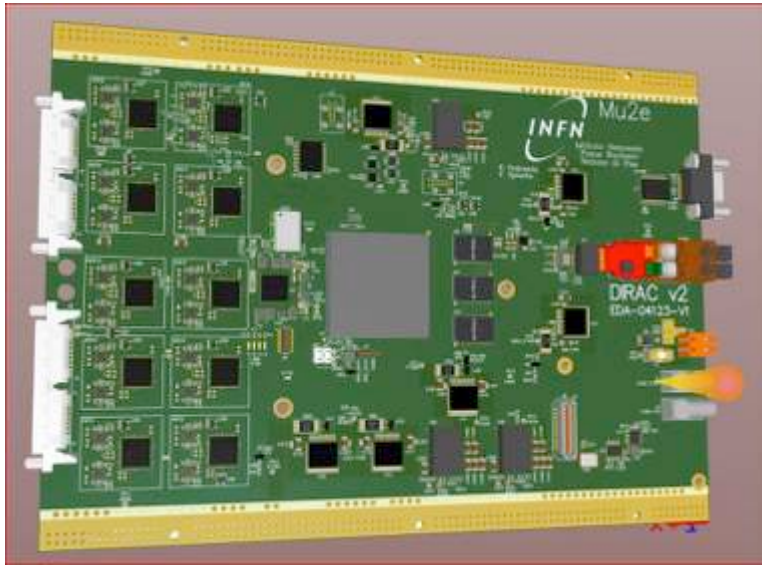
- **TENDERs for 3500 FEE boards done last week from INFN**

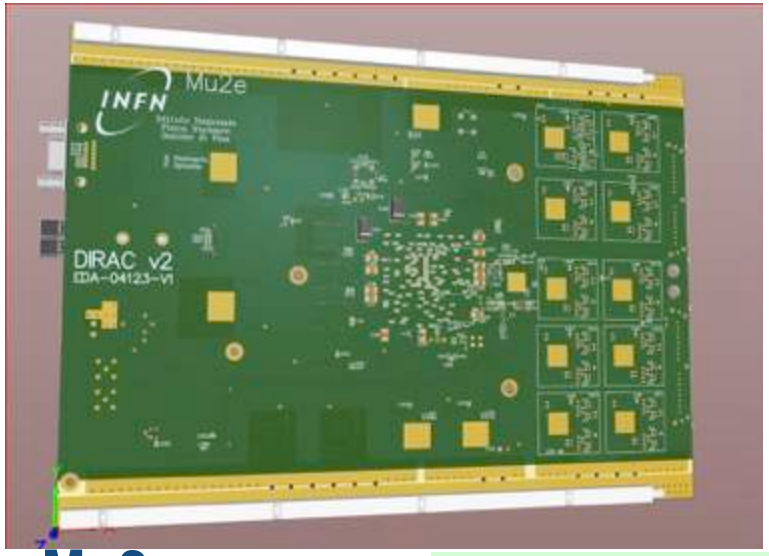
  ➔ Firm selected (ARTEL SPA)
  ➔ 10 prototypes for rad-hard test in January
  ➔ Pre-production of 350 pieces in February
  ➔ Full production of 3150 pieces in spring

- **Tender for 840 (x 4) SIPM/FEE/MB cables done last week from INFN**

  ➔ Cables will be produced by SAMTEC as for the prototypes tested in the last 4 months
  ➔ Outgassing/Radiation/B-Field tests OK
  ➔ Routing path tested in Mockup

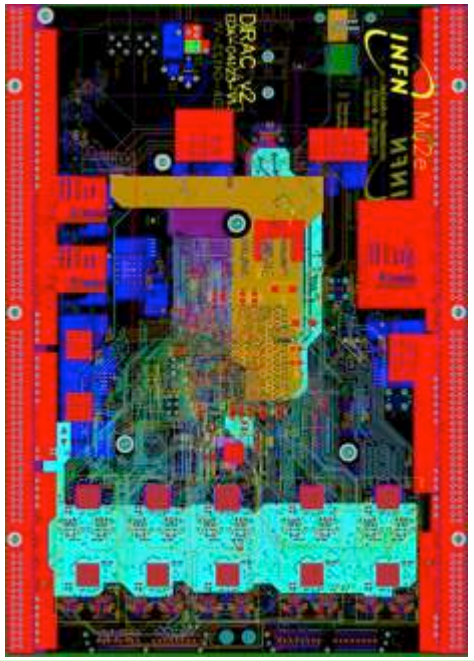
Progress N. 3: DIRAC V2 prototypes





- FPGA PolarFire Rad-Hard
- VTRX readout (TDAQ)
- Analog Input and ADC firmware as in V1

- **5 assembled boards ready in Pis**



Test In progress both for Board functionality + Vertical Test with TDAQ

CRR review planned for February 2020

Progress N. 4: Calo Assembly Room

- Practically completed
- Access with crane for Calo truck loading
- Temperature and Humidity controlled and monitored
- Portable crane inside for components

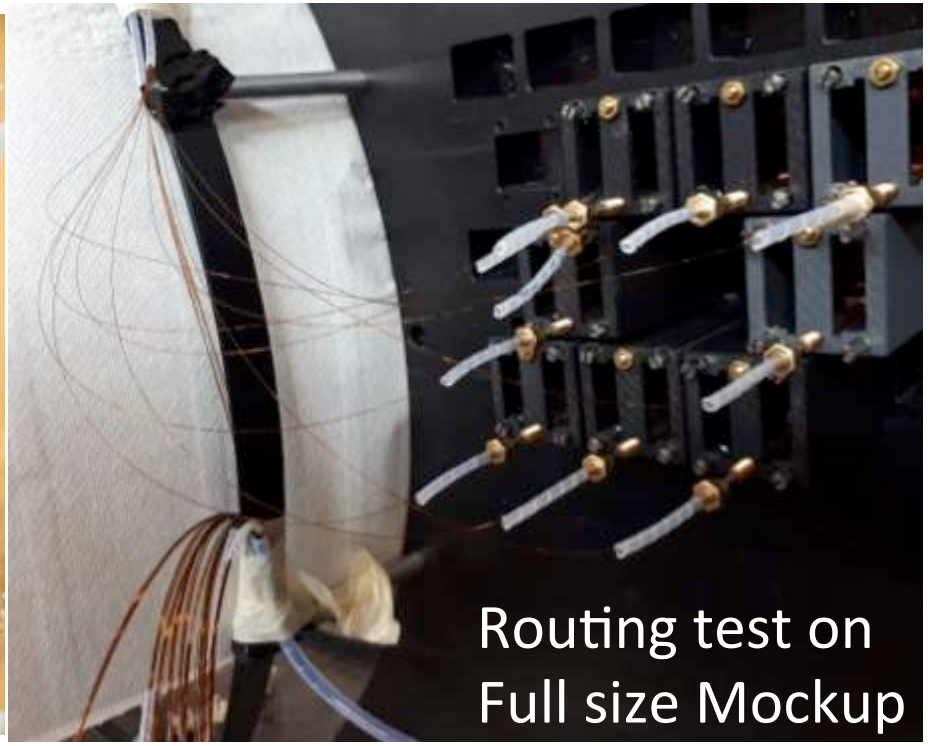
- One mechanical assembling region
- One electrical and data acquisition region
- Testing of half disk a time

- Nitrogen and compressed air installed
- Electrical implant finished
- **fire alarms done**
- **calibrating HEPA and HVAC system**

- sealing small openings

- cleanroom class verification

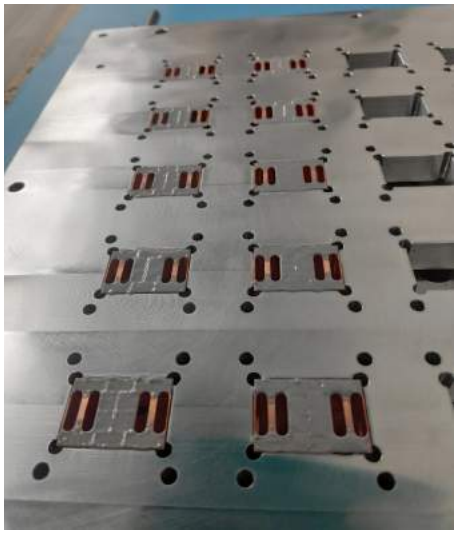
Progress N. 5 : Laser system

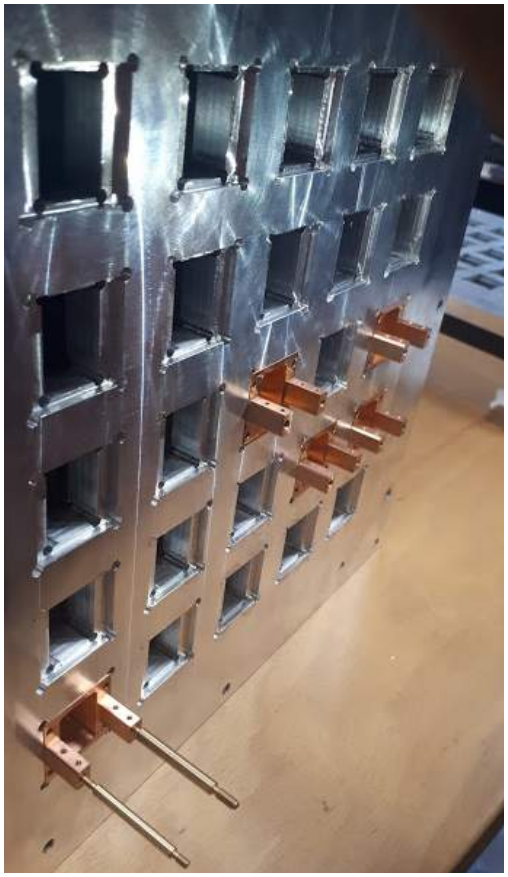


- Pre-production fiber bundle with 110 quartz-quartz-fiber delivered (tested up to 100 krad, outgass in progress, very good bundle uniformity of ± 6%)
- Routing test done in mockup. Handling resulted to be easy with uniformity unmodified after handling.

Progress N. 6: SiPM-glueing procedure OK

- Tooling for starting gluing procedure delivered from LNF to Sidet
- Small production of “pre-mixed” EP30AN from MasterBond done
- Pre-production test done at end of November
- Production of SiPM holders started
- SiPM/Glueing operation scheduled for Feb 2020 in Sidet
- 25 Holders/tooling x 2 tooling x 2 runs/day =
  100 Holders/day → 15 working days, 1 month operation





Deliverables & Milestones

→ **D2.1 (TDR) Month 12**
→ **D3.3 (Design Laser system) Month 18**
→ **D4.2 (Development of Simulation Code) Month 32**
→ **D2.2 (Production DB for Crystals and sensors) Month 36**
→ MS2 (Assembly of the first calorimeter disk) Month 42

Calorimeter disk assembly delayed of more than 1 year

➔ CRR of mechanics done in May 20
➔ CRR review for FEE Completed/proto MB/DIRAC V2 arrived
➔ PCB review and CRR of MB/DIRAC for Feb 2020
➔ Complete Disk mechanics expected for late spring 2020
➔ FEE delivery expected for late spring 2020
→ Assembly start now planned for late spring 2020
→ **it will still be a great result to have the aluminum disks at FNAL for Feb 2020**


WISHING YOU A
MERRY
CHRISTMAS
&
HAPPY NEW YEAR