INTENSE: particle physics experiments at the high intensity frontier, from new physics to spin-offs. A cooperative Europe – United States – Japan effort



Mu2e ECAL Electronics

Elena Pedreschi November 28th, 2022, Pisa



H2020 MSCA RISE 2018 GA 822185



Calorimeter design



Calorimeter disk

S-G C0063	SIC C0071
S-G C0065	SIC C0072
S-G C0066	SIC C0073

CsI crystals



CsI + SiPM + Holder + FEE



SiPM + Holder + FEE



UV-extended SiPMs

 High granularity → 1348 undoped CsI crystals (3.4x3.4x20 cm³)

- Crystals arranged in 2 disks (inner/outer radius 37.4 cm / 66 cm, separation between disks 75 cm)
- 1 crystal coupled to 2 UVextended SiPMs (14x20 mm² area) → 2696 electronic channels
- SiPM packed in a parallel arrangement of 2 groups of 3 cells biased in series
- DAQ *crates located* inside the cryostat to limit the number of pass-through connectors

Calo electronics: FEE

✓ 3510 FEE boards produced, 3300 shipped to JINR for calibration

- ✓ Two levels QC : Burn-IN in climatic chamber, Calibration of HV, amplification and signal shape.
- \checkmark 2500 done and back to LNF \rightarrow HV calibration performed again @ LNF for cross-check
- ✓ 800 still at JINR → problems due to Ucrain- Russia war

Very difficult to get them back yet Elevated to Risk → New production required??







Apart temporary good news from JINR, it looks time to act Risk of 800 Boards realized (INFN/DOE) \rightarrow new prod in progress

Mezzanine Board

After a disaster of first pre-series in March

- New pre-series v2, 14 Mboards at LNF
- Perfect production. Burnin test is OK
- Halted production to wait results of proton tests
- 10 V1 pre-series being reworked for test usage









DIRAC Board



- V1 (2019)
- FPGA Microsemi SM2
- Daisy chain readout
- Some radiation issues (DCDC converters and FPGA)



- V2 (2020)
- Major revision
- FPGA Microsemi Polarfire
- DCDC LM36606
- Point to point readout



- V3 (2022)
- Minor revision
- Improved rad-hardness
- Backup solution for VTRX





Argonne ✓ Production Order already assigned to DF electronics

- \checkmark In preparation to CRR we:
 - → Worked on completing the firmware integration with Fiber Readout
 - → Made tests on B-Field at Argonne (very succesfull)
 - → Worked for mitigating the Polar Fire FPGA delivery delay iss first half expected for December 2022

Crates installation

- All crates assembled and connected to the manifold
- Crate connection to G10 supports made more robust inserting screws threads instead of direct thread in G10





Distribution boards for LV and HV power lines



Cable routing



Conclusions

Years 2023 and 2024 will be "hot" for Mu2e electronics and DAQ

- Commission the Mu2e electromagnetic calorimeter DAQ electronics
- Commission the electromagnetic calorimeter in the Mu2e experimental area
- Commission the Mu2e experiment with cosmic rays and get ready for muon beam
- Optimize Mu2e detectors calibration procedures
- Quantify Mu2e detectors performance
- Begin Mu2e data taking
- Review lessons learned from Mu2e to inform the design of the upgraded Mu2e-detector