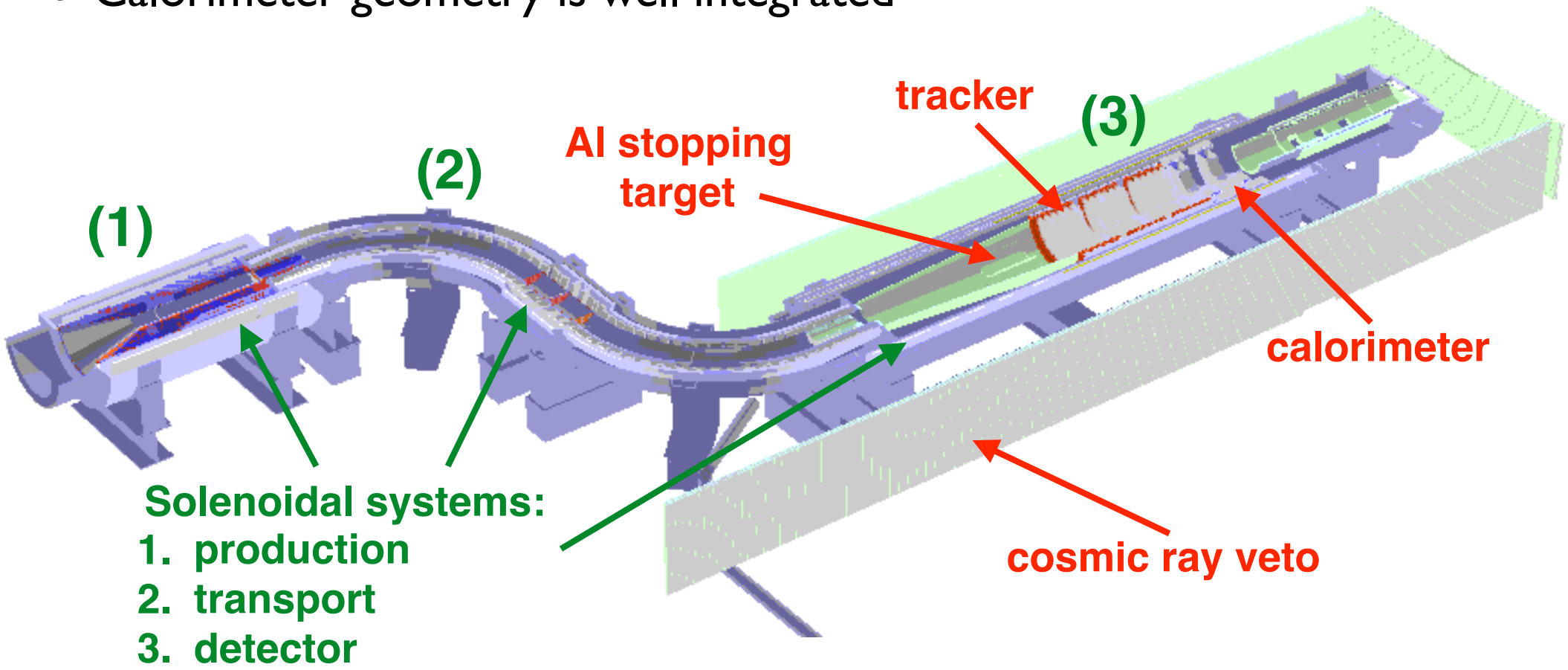
Mu2e calorimeter simulation studies

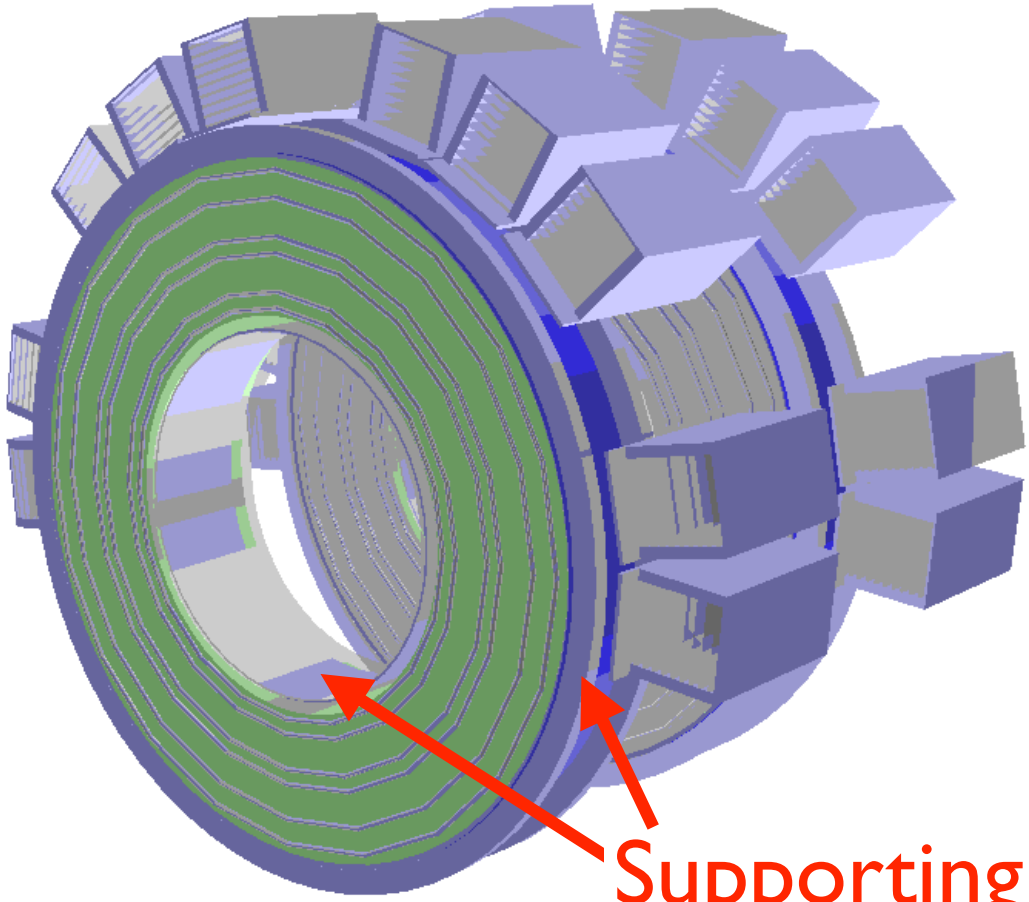
Calo-simulation status

- Particle-matter interactions embedded with GEANT4 in the Mu2e framework
- Calorimeter geometry is well integrated

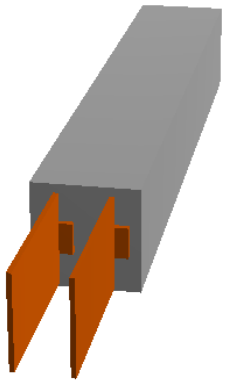


Geometry - details: why?

- High level geometry description allow us to estimate the expected dose and neutron flux in all the sensitive components: crystal and electronics
- These estimates are extremely relevant for the QA tests

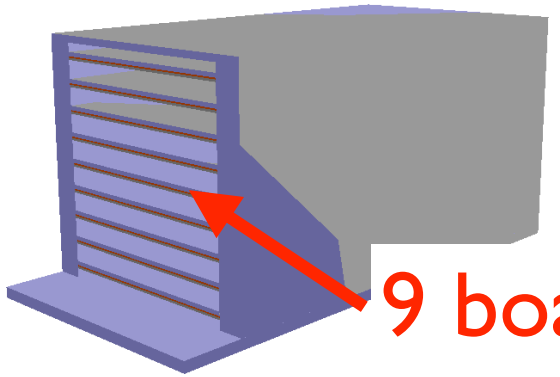


crystal "unit"



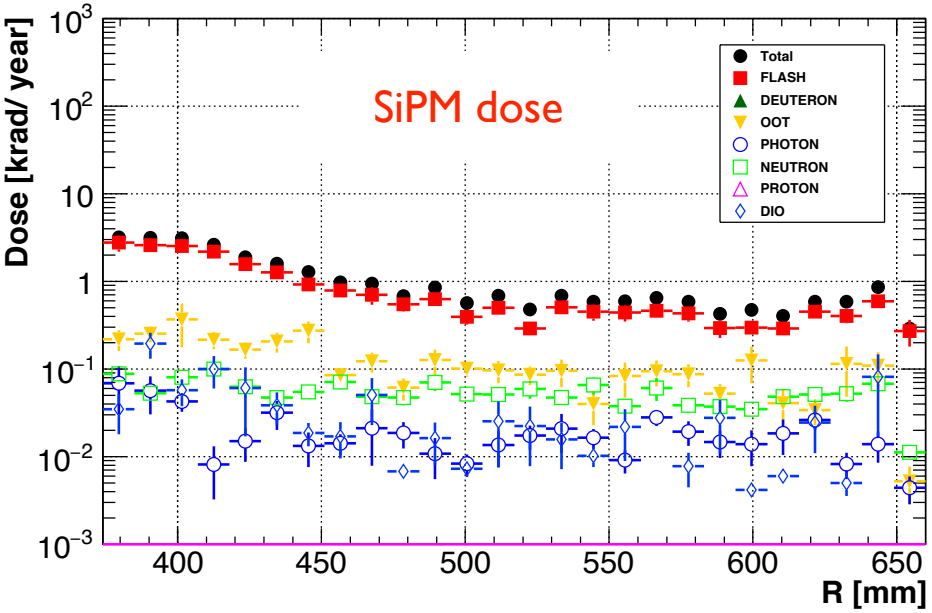
★un-doped CsI
★wrapping
★SiPM
★FEE

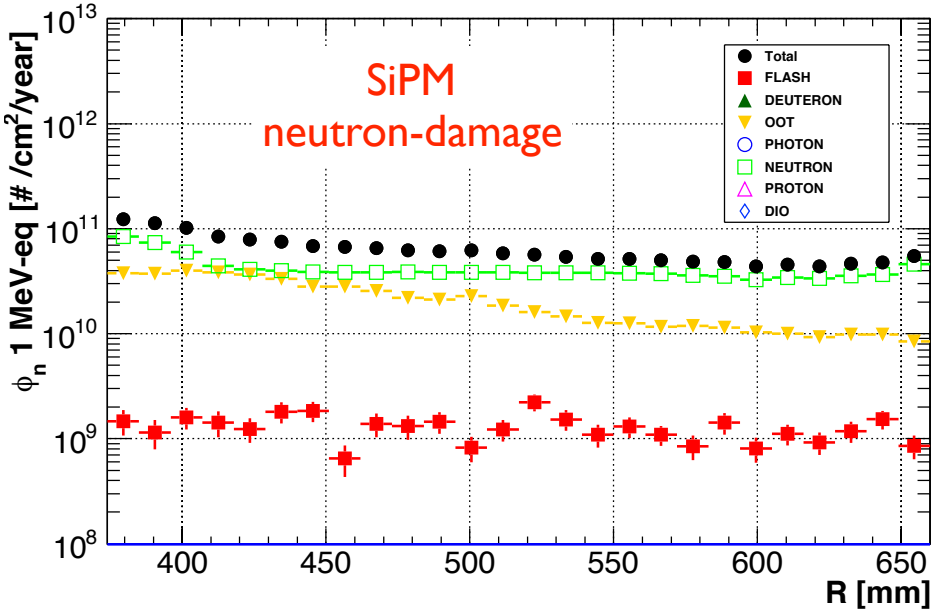
crate Al case



Dose in the SiPM & FEE

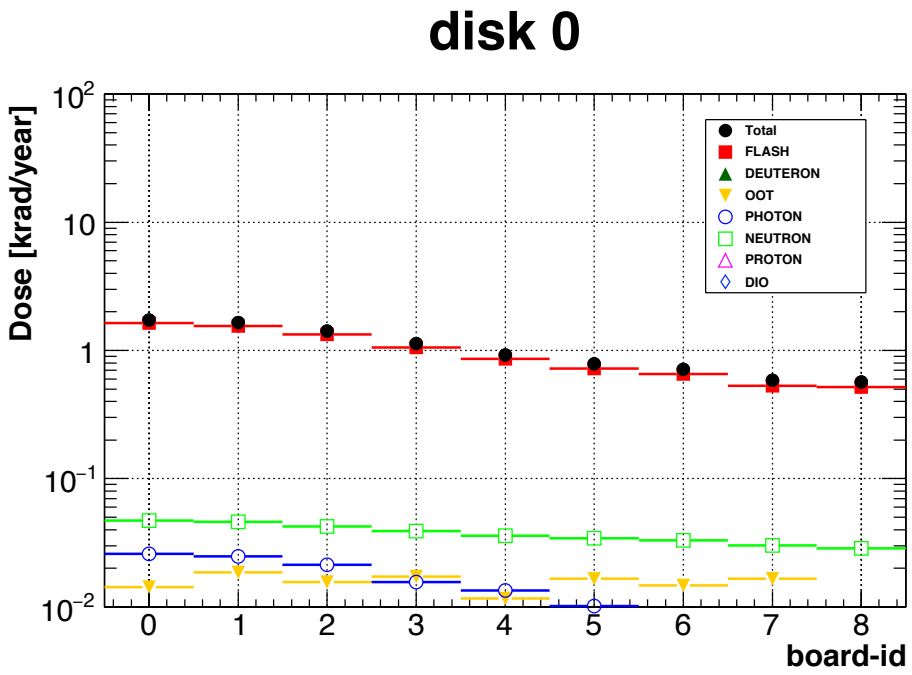
- High level geometry description allow us to estimate the expected dose and neutron flux in all the sensitive components: crystal and electronics
- These estimates are extremely relevant for the QA tests

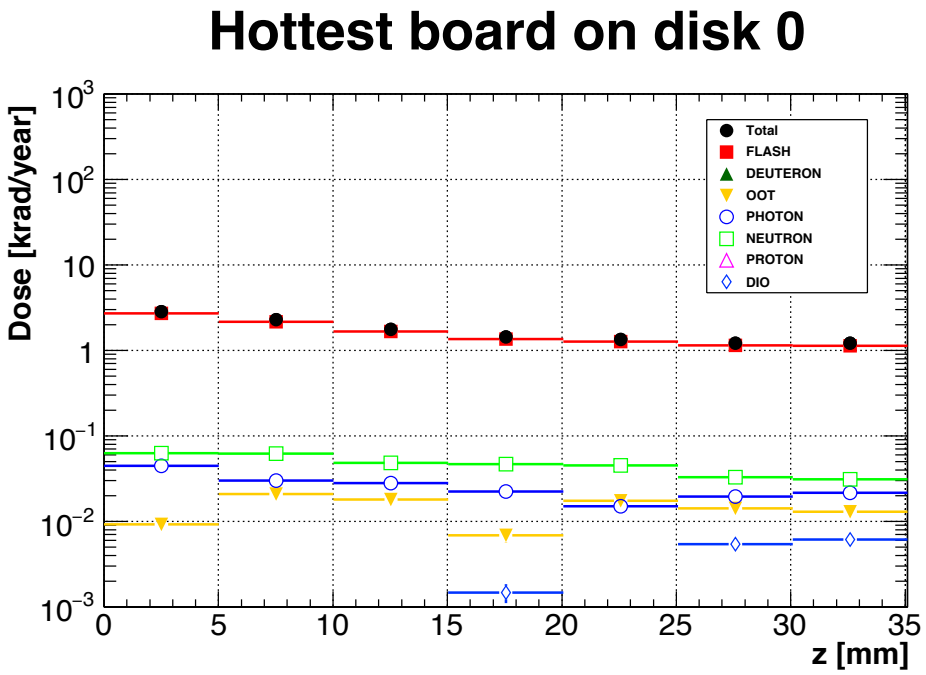




Dose in the crates

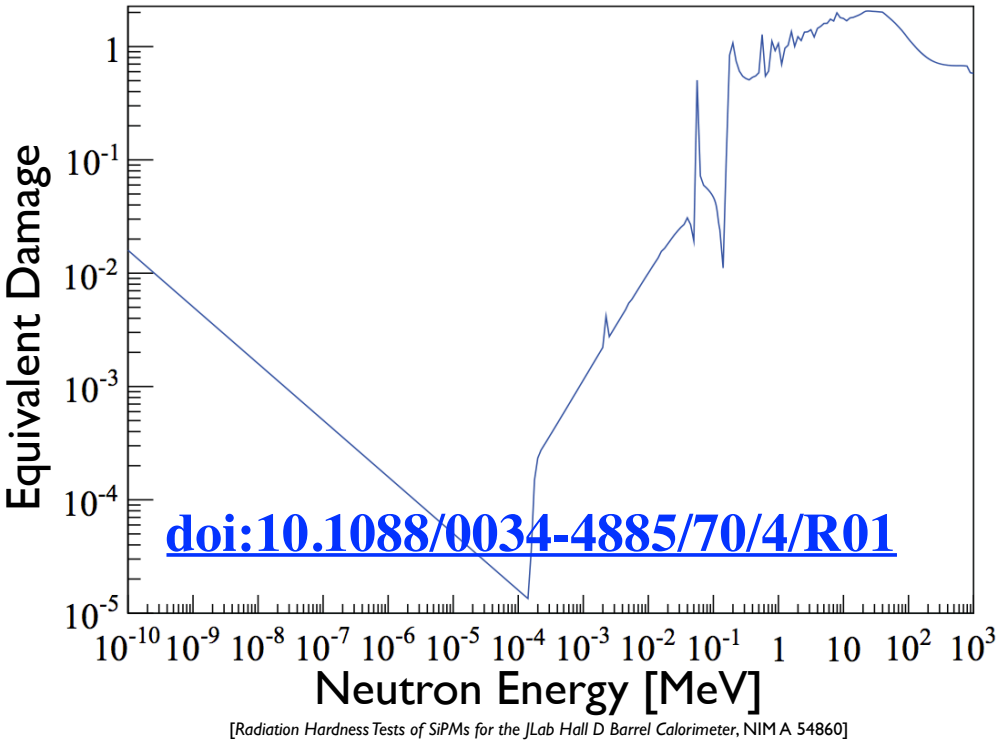
- Dose is averaged over the 10 crates
- The hottest board is the one closer to the crystals: 3 to ~1 krad



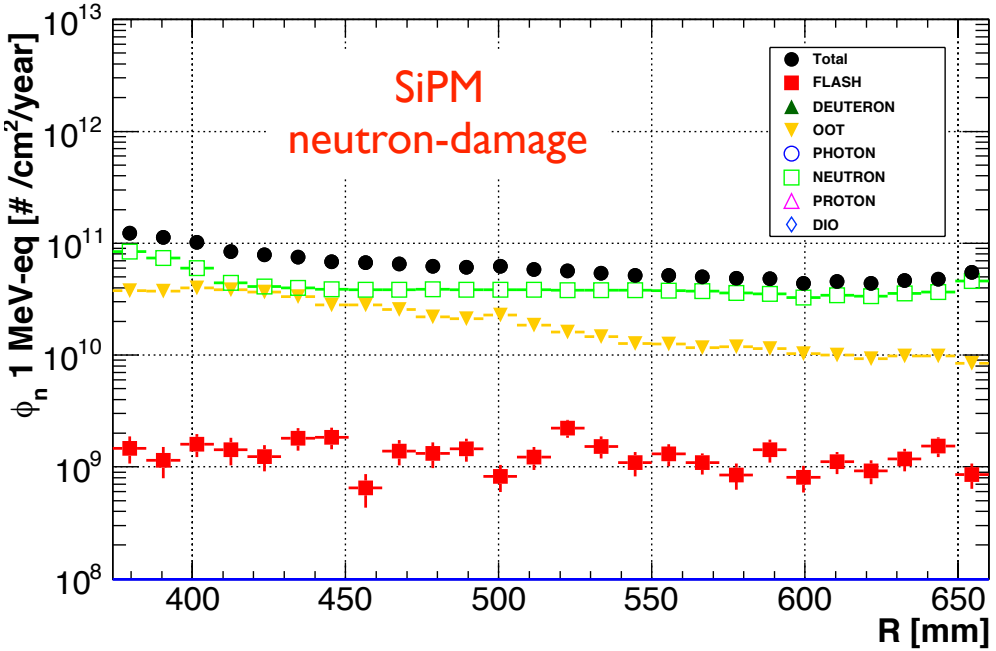


Neutron damage

- Bulk damage in Si device from neutrons is dangerous, especially for SiPM
- Worst case: expected neutron flux 1 MeV-eq at the SiPM ~ 10^{11}
- Interestingly, GEANT4 results match nicely with MARS!



[*Radiation Hardness Tests of SiPMs for the JLab Hall D Barrel Calorimeter*, NIM A 54860]

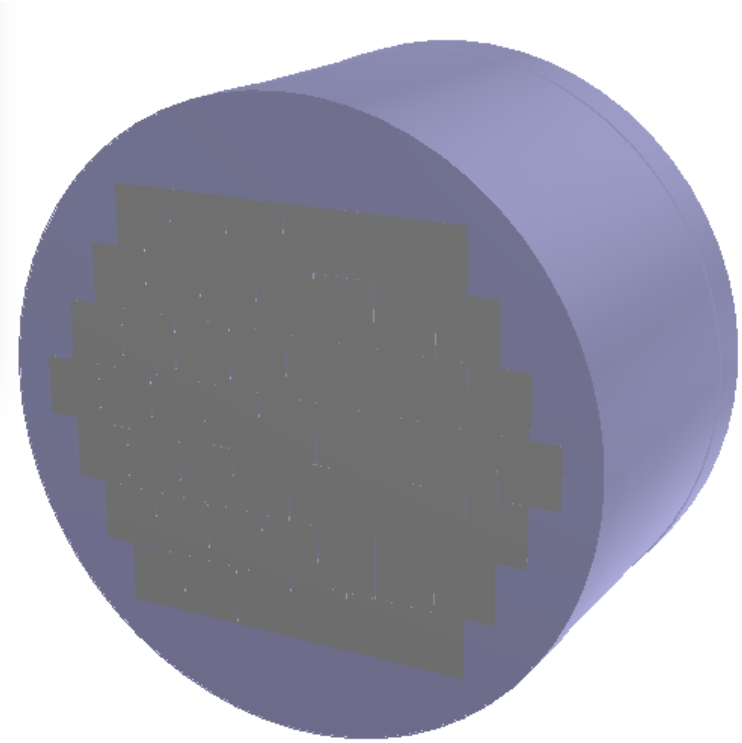


Software for beam tests (1)

- Mu2e Offline is also used to simulate the expected response of the calorimeter prototypes
  - One test beam analyses already finalized
  - New test beam with "module 0" is ongoing!

Module 0

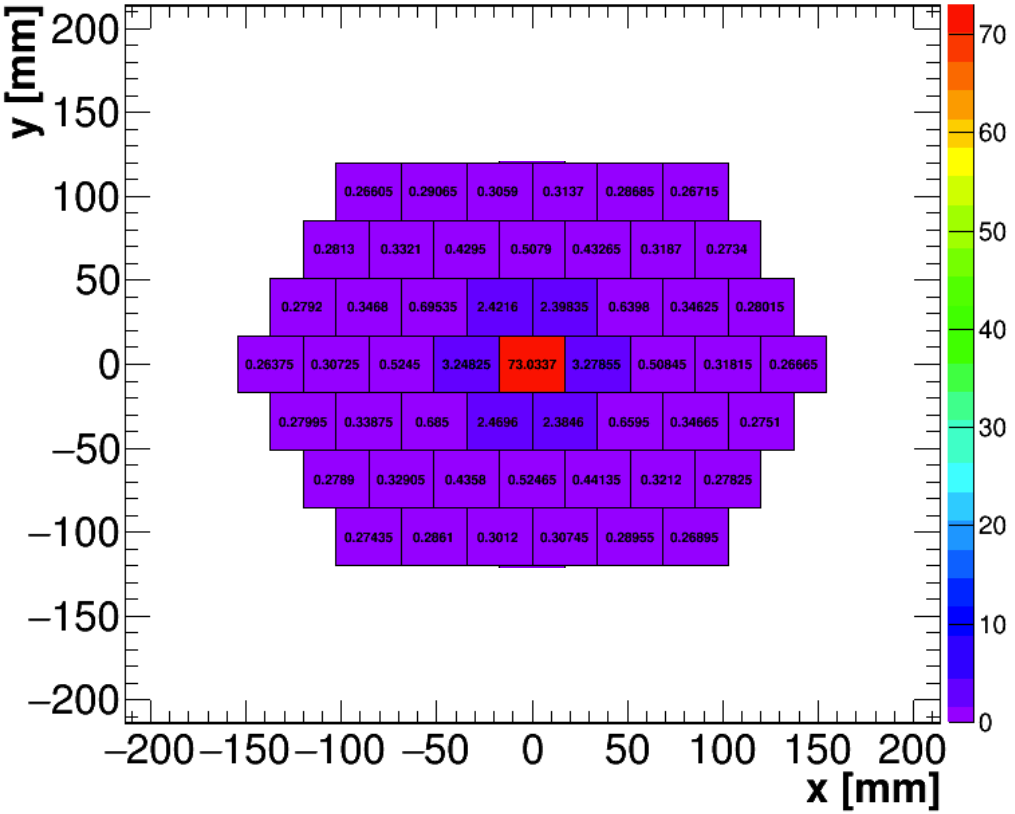
simulation is ready!

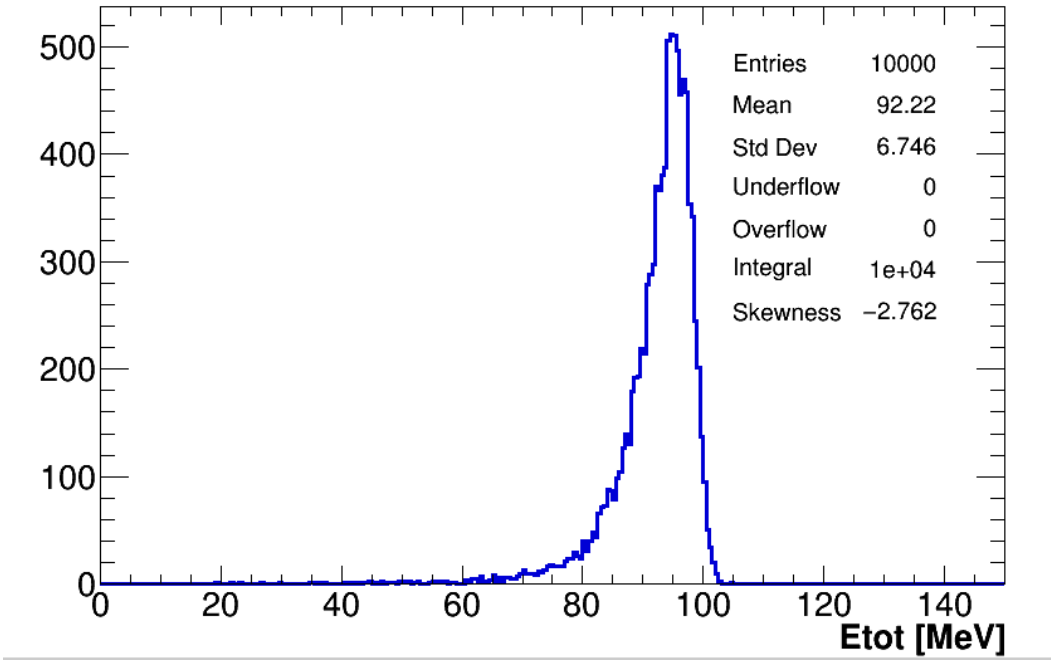


Software for beam tests (2)

- Beam test results will be used to tune the Mu2e simulation
- Several configuration to test: "head on" and tilted configuration

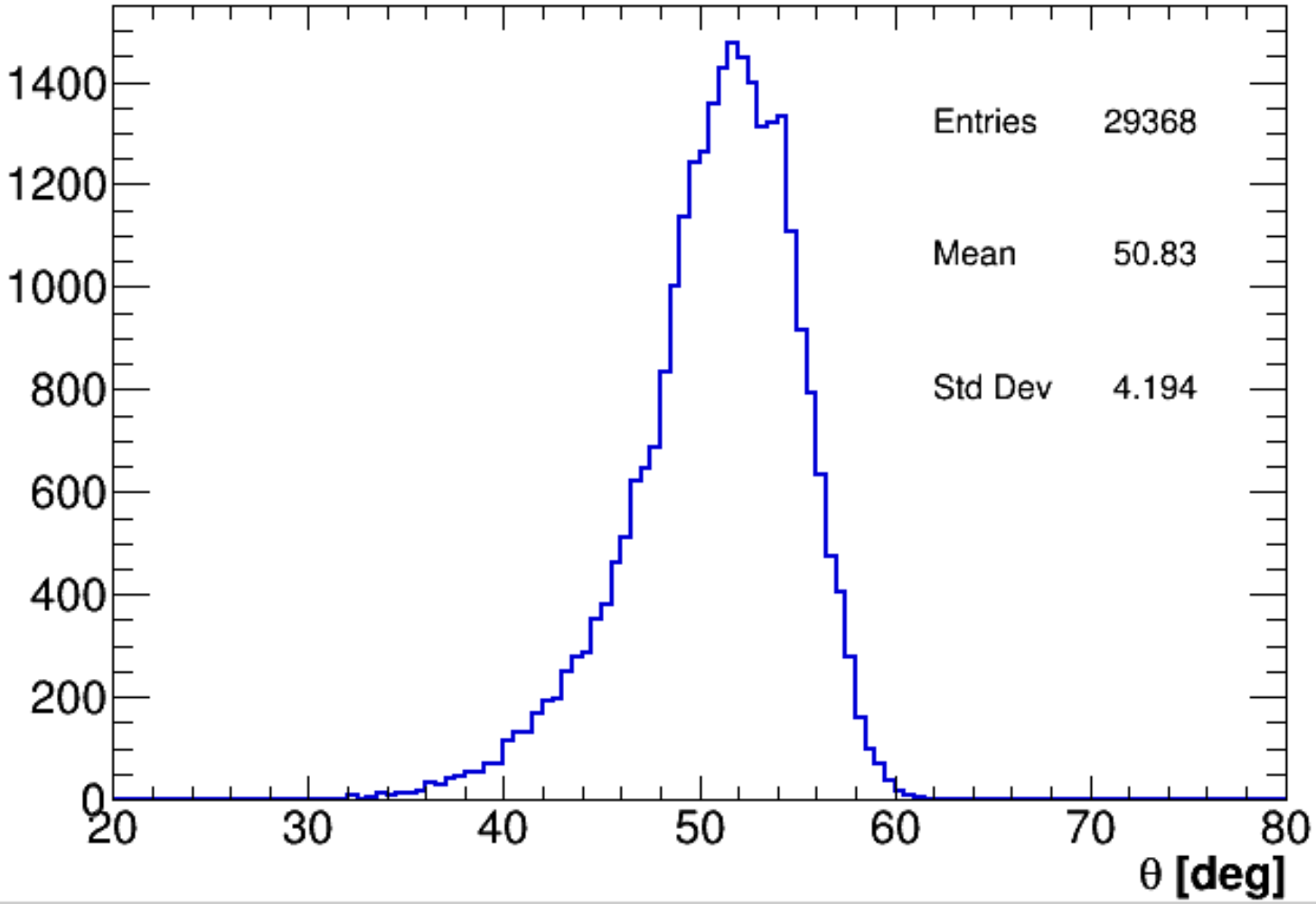
beam head on





Why tilted?

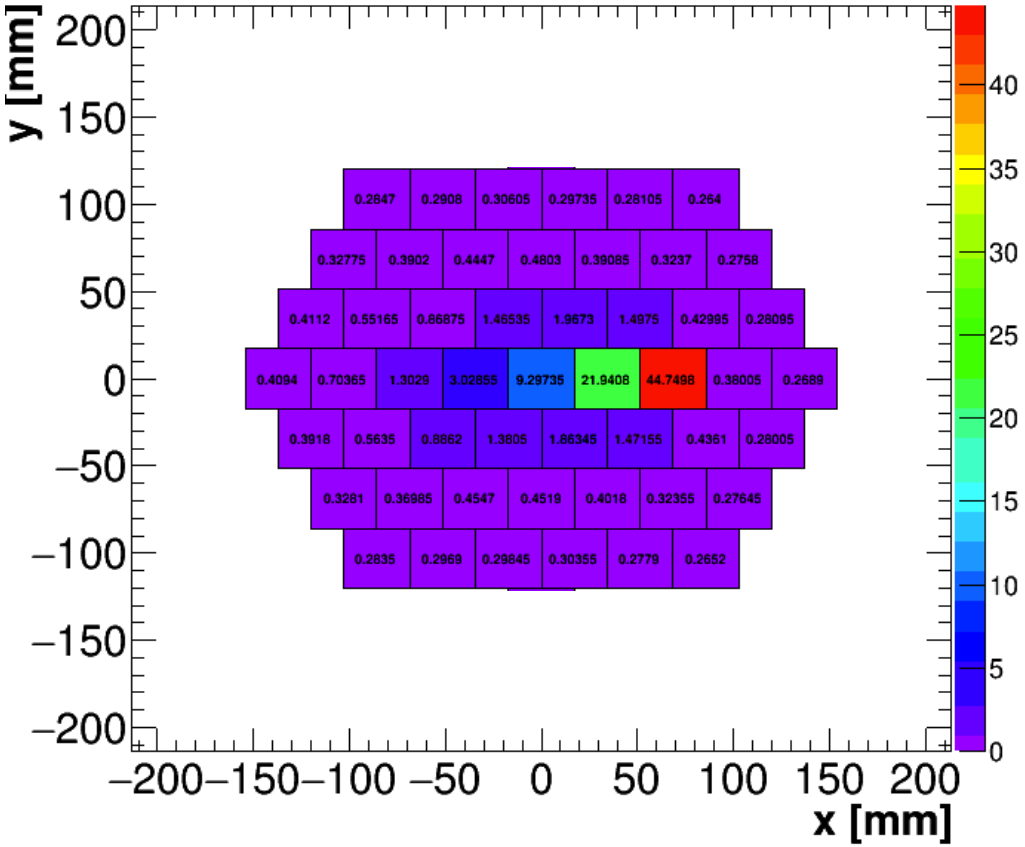
- In Mu2e the signal does not impact orthogonally!

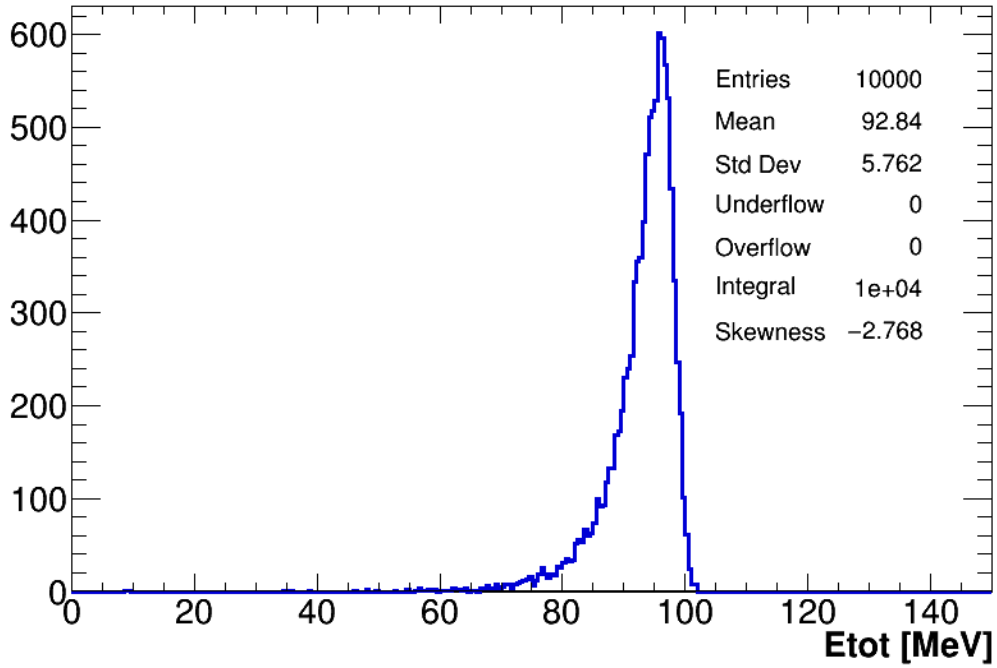


Software for beam tests (3)

- Fairly large number of runs in the tilted configuration are scheduled
- Data-MC matching in this configuration is crucial for us

example: beam @ 50 deg





Conclusion

- The Mu2e software has been used to characterize the harsh condition we expect to face during the data taking
- Estimates of the expected level of dose and neutron radiation is necessary to optimize the detector design and select the QA tests
- The Mu2e software has also been employed in the test beam data analyses no validate the MC and the reconstruction techniques
- Lots of work still needs to be done!