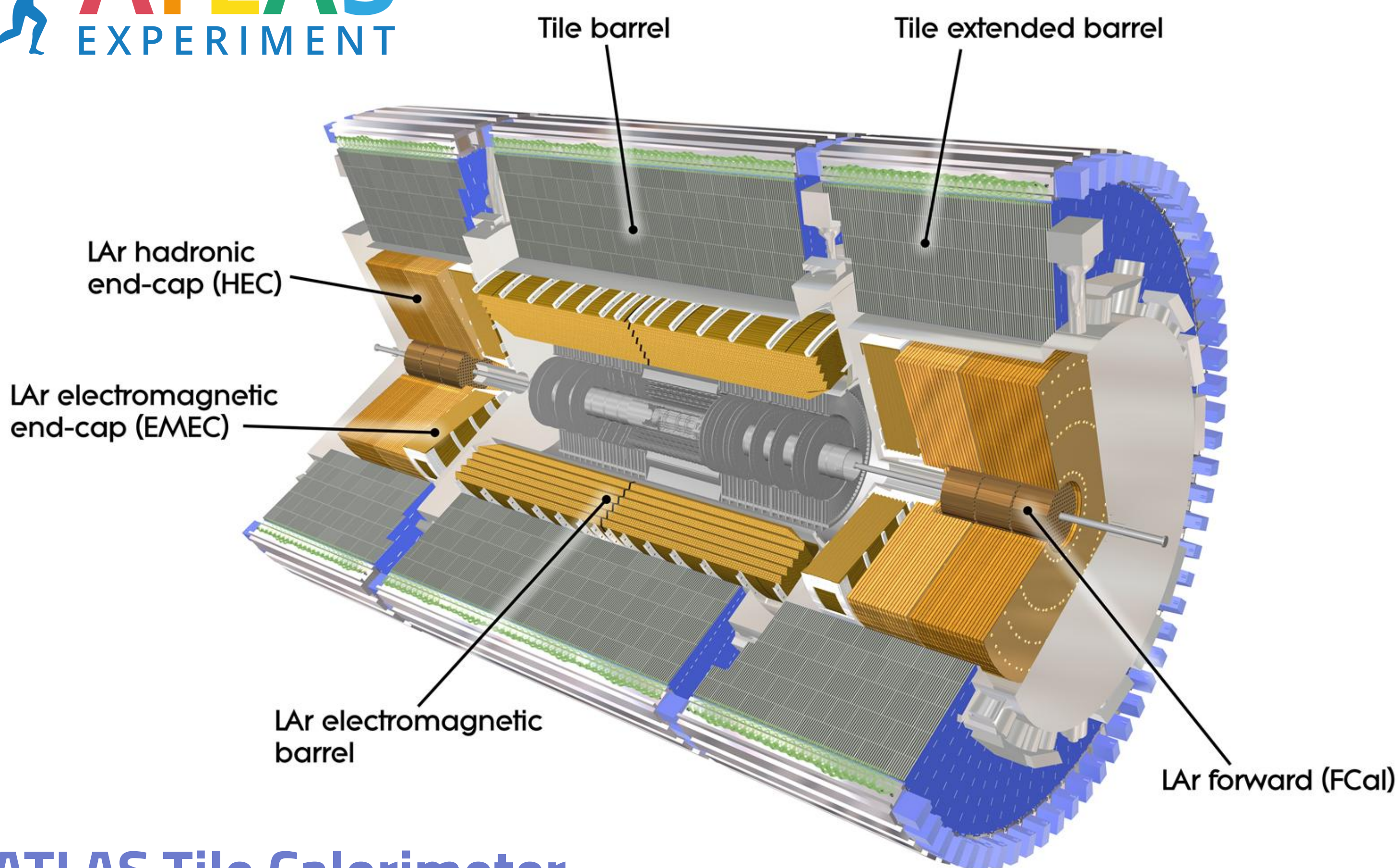


# Performance and Optics Robustness of the ATLAS Tile hadronic calorimeter

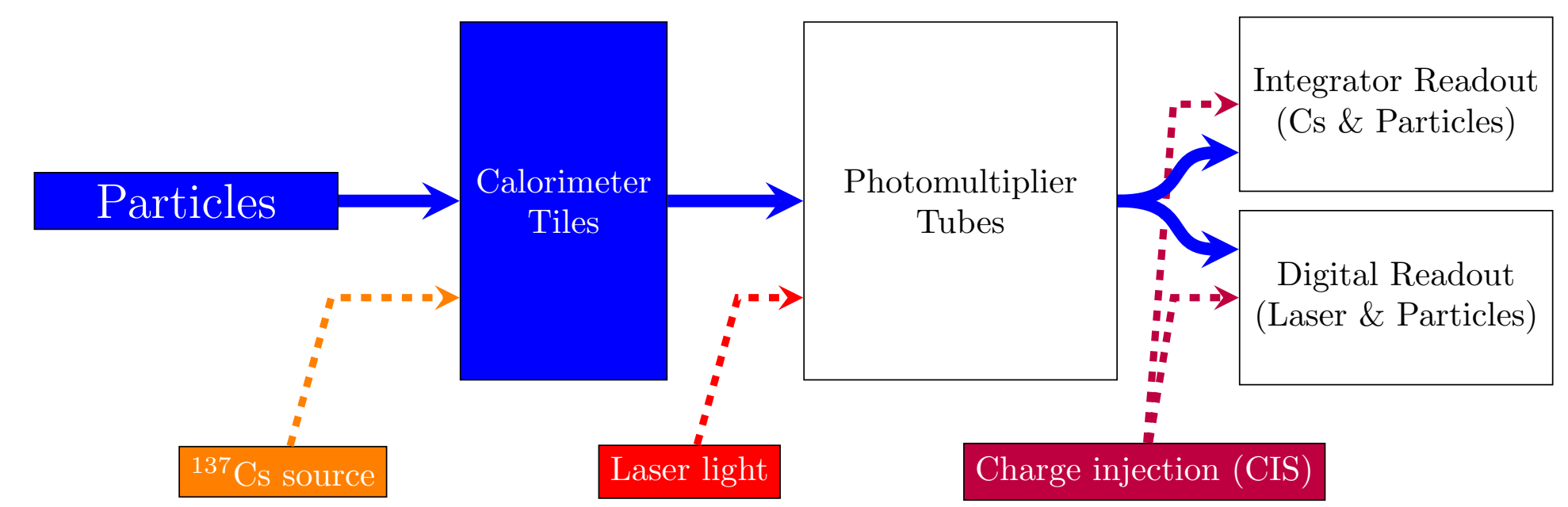


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## Calibration

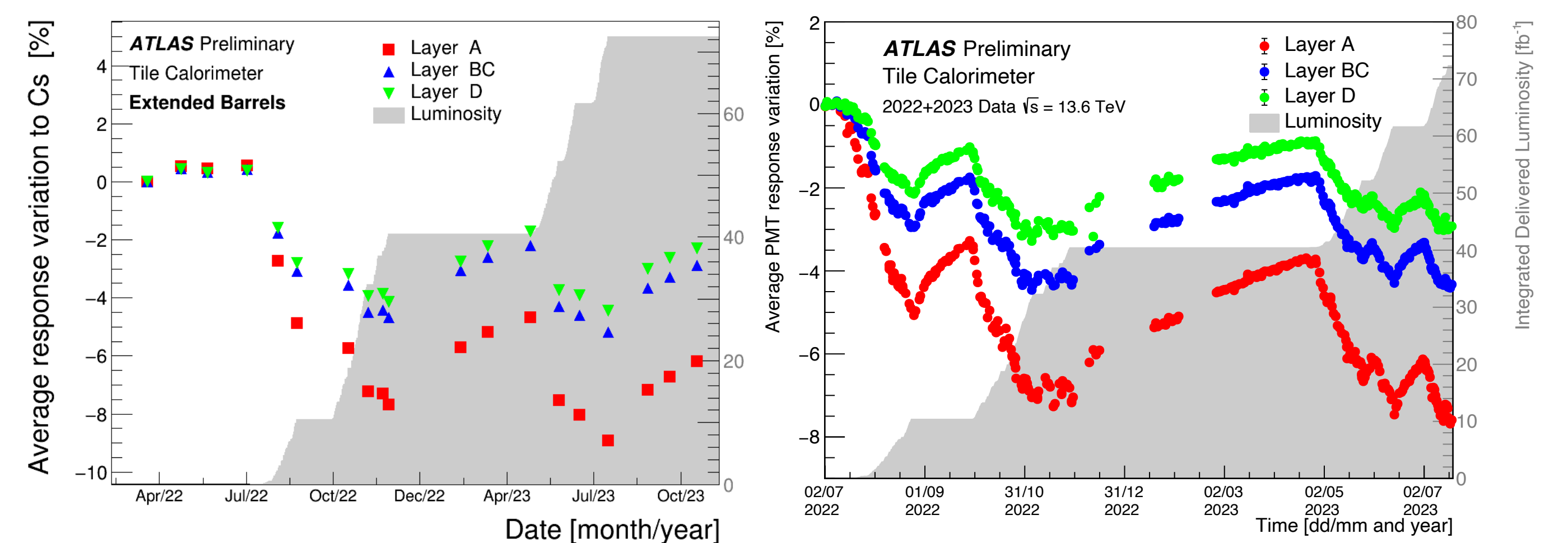
Dedicated systems monitor and calibrate each step of the readout chain.



Charge-injection calibrates the readout electronics.

$^{137}\text{Cs}$  source scans the whole detector probing scintillation, light transport and photodetection. Detector response decreases with operation, more significantly in high particle fluence regions, but recovers during stops.

- ▼ Laser system dispatches short light pulses into each PMT using a chain of clear optical fibres. Calibration runs taken daily.



## ATLAS Tile Calorimeter

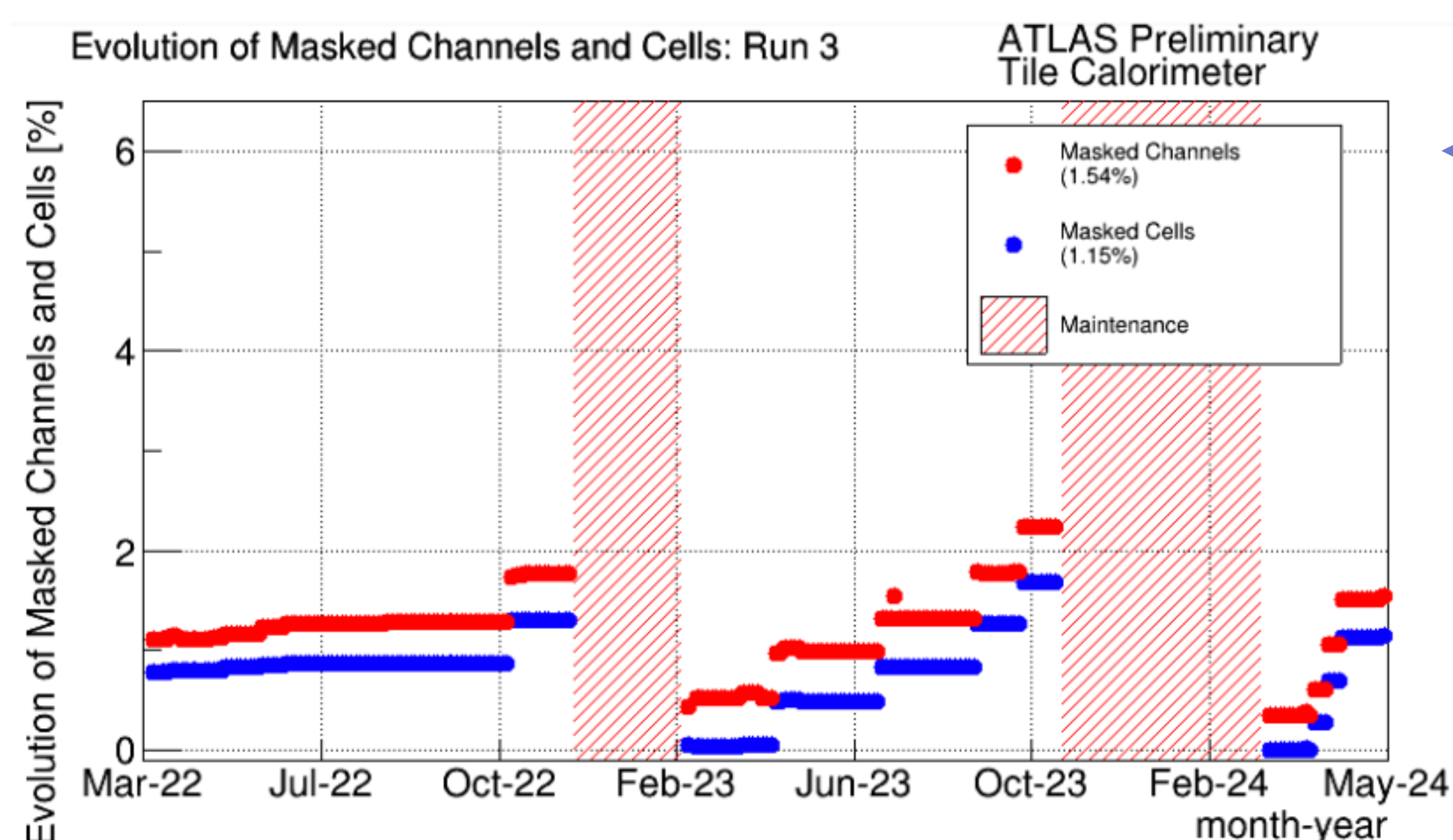
Central hadronic calorimeter of the ATLAS experiment at the LHC, covering  $|\eta| < 1.7$ :

- Sampling calorimeter featuring plastic scintillators interleaved with steel;
- Measures hadrons, jets, hadronic decays of  $\tau$ -leptons, missing transverse energy;
- Provides analog input to the Level 1 hardware calorimeter trigger.

Double photomultiplier (PMT) readout through wavelength-shifting optical fibres:

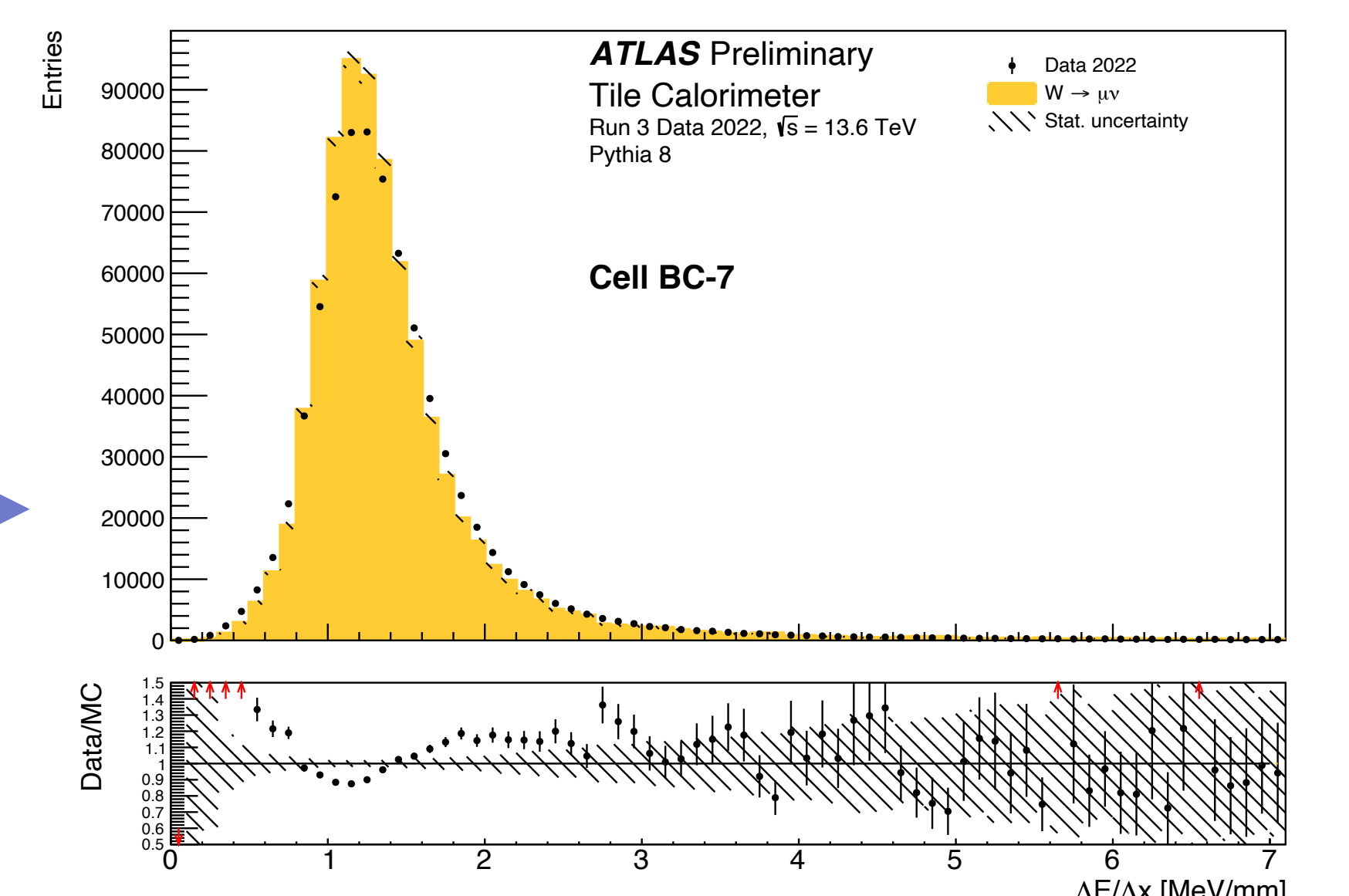
- 64 wedged modules, 3 radial layers: A, B(C) and D;
- 9852 readout channels, 5182 unit cells;
- 0.1/0.2 x 0.1 cell granularity in  $(\eta, \phi)$ .

## Operation and Performance



Continuous data quality activities and maintenance campaigns keep the fraction of non-functional readout channels below 2%.

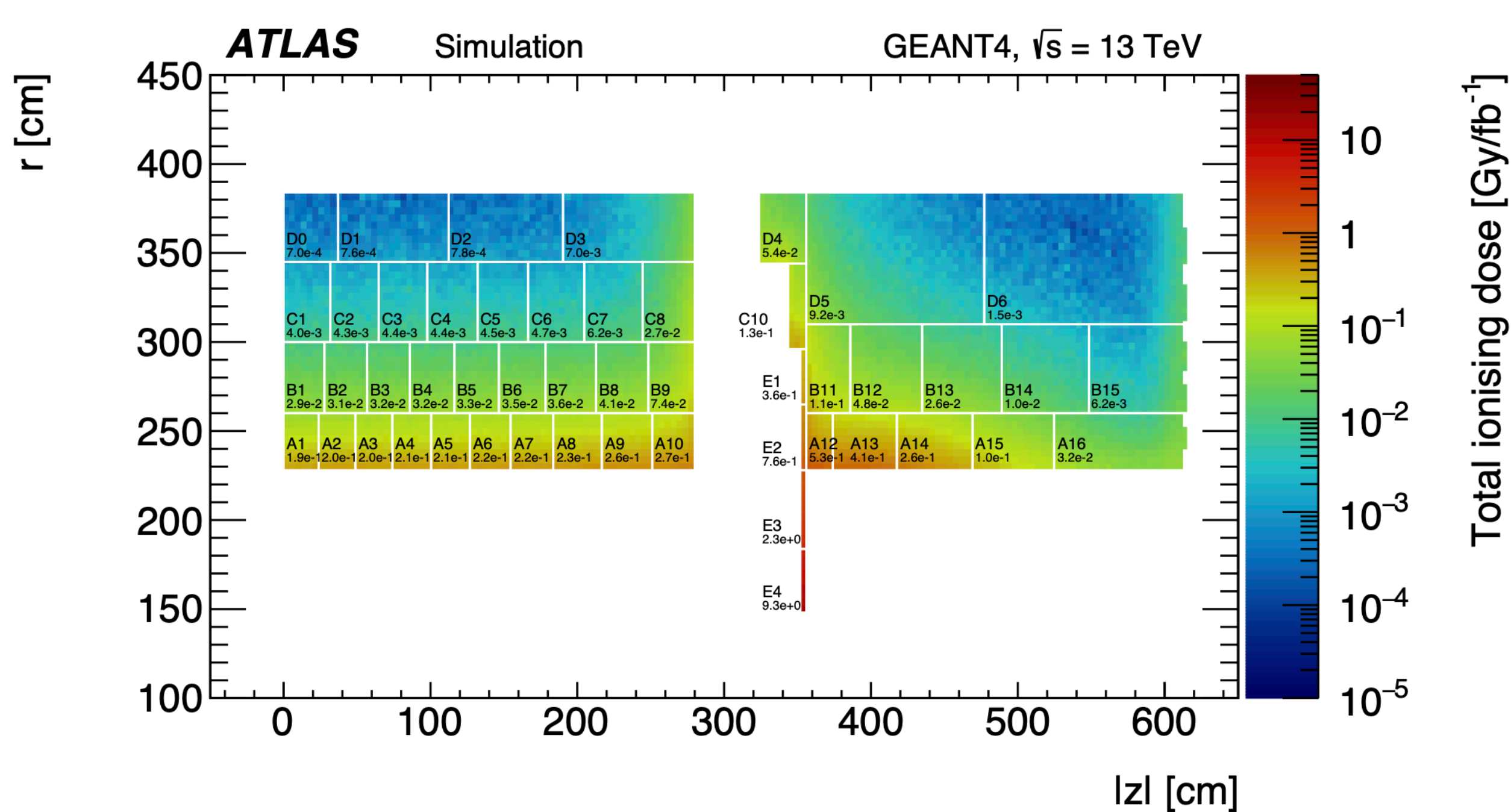
Events with isolated muons from  $W$  boson decays used to probe data calibration and simulation accuracy.



## Optics Robustness

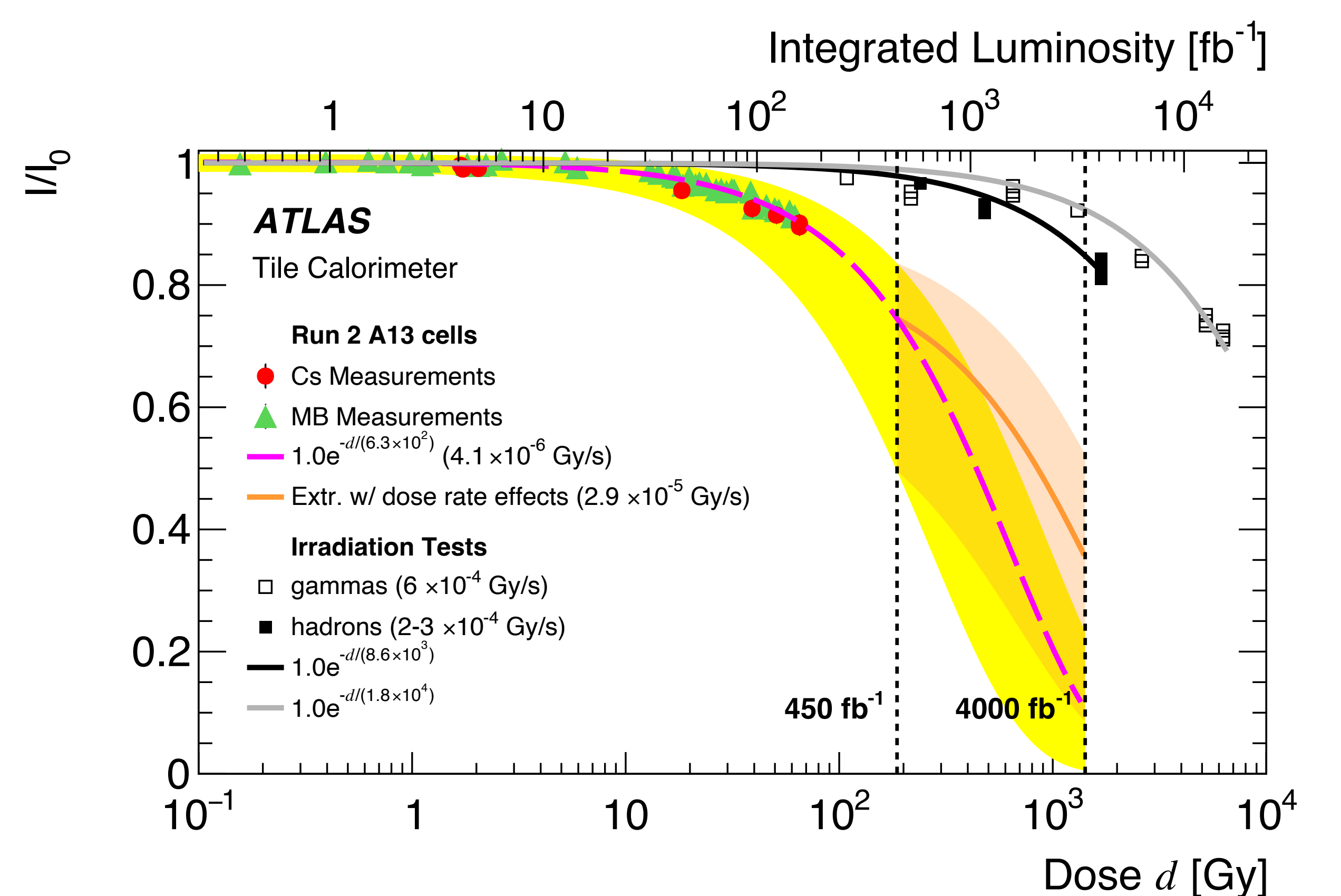
Plastic scintillators known to suffer from radiation damage.

- Dose deposited in the active material simulated with Geant 4;
- Average cell light response  $I/I_0$  measured with data from the calibration systems;
- Light response loss from 2015 to 2018 up to 10%, correlated with dose exposure.



High-Luminosity (HL) upgrade plan for LHC is a challenge to the detector's optics.

- Extended operation leads to much higher doses than design requirements;
- Current light response measurements modelled as a function of dose and dose rate;
- Expected dose rate larger by a factor up to 7 reduces degradation rate;
- Extrapolation to the end of HL-LHC: most exposed cells will maintain 40% light response.



## References

CERN-LHCC-96-042 / Eur.Phys.J.C70:1193-1236,2010  
JINST 8 P01005 (2023) / arXiv:2401.16034 (sub. to EPJC)

## Acknowledgements

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