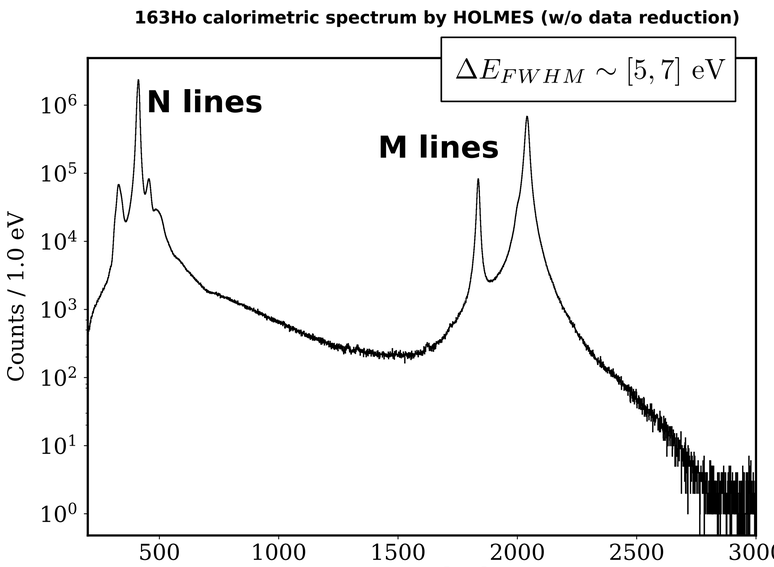
# The first neutrino mass limit of HOLMES

Matteo Borghesi, on behalf of the HOLMES collaboration



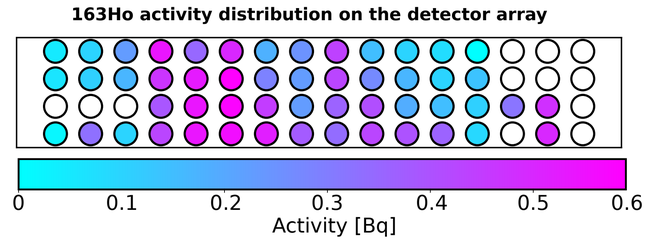

- Direct **calorimetric** neutrino mass measurement with 163Ho.

  $$m_\beta = \sqrt{\Sigma_i |U_{ei}|^2 m_i^2}$$

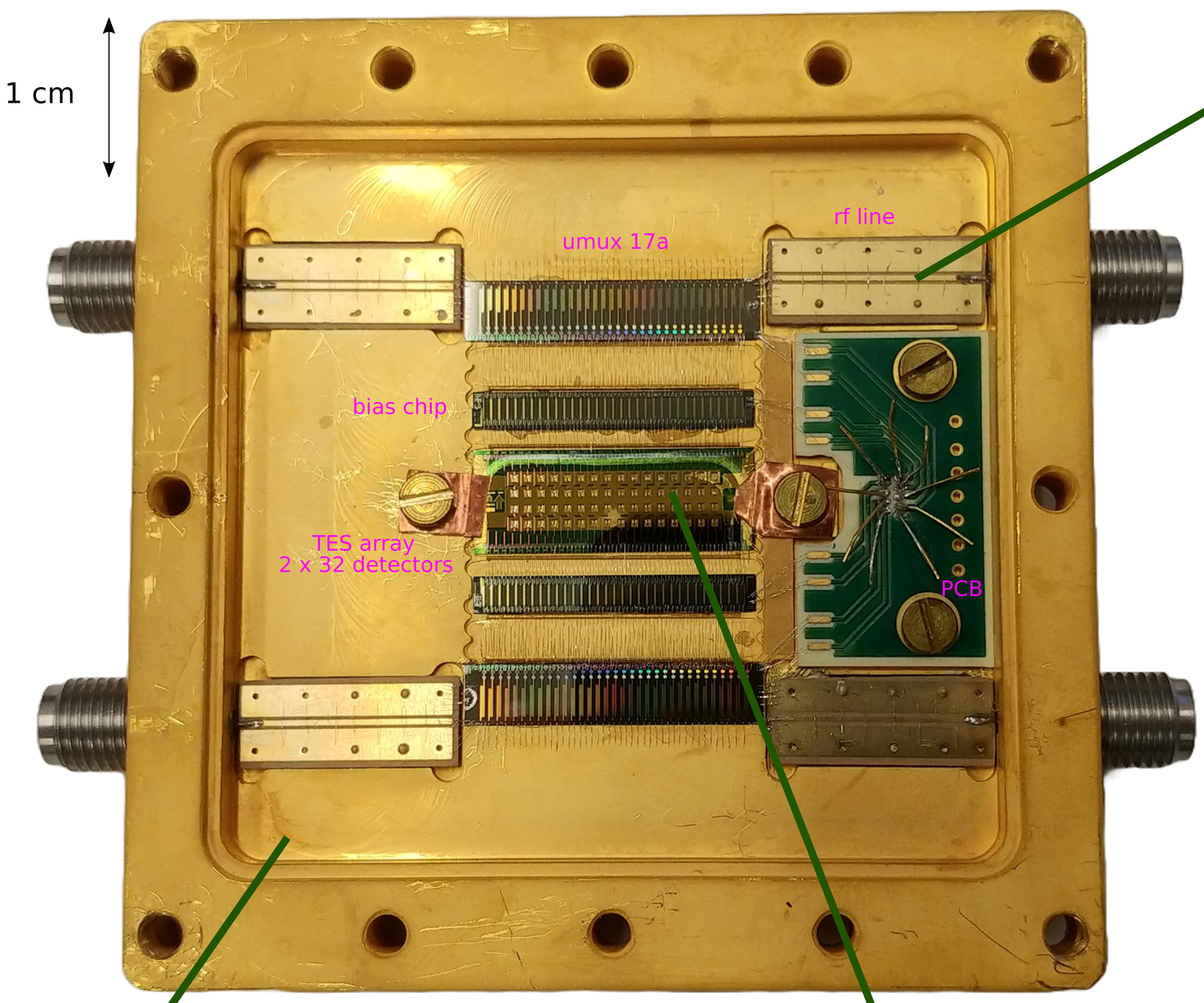
  All the energy of the decay is measured except for the energy of the (electron) neutrino.

- HOLMES **goal**: to prove the feasibility of the calorimetric technique for a next-gen neutrino mass experiment.

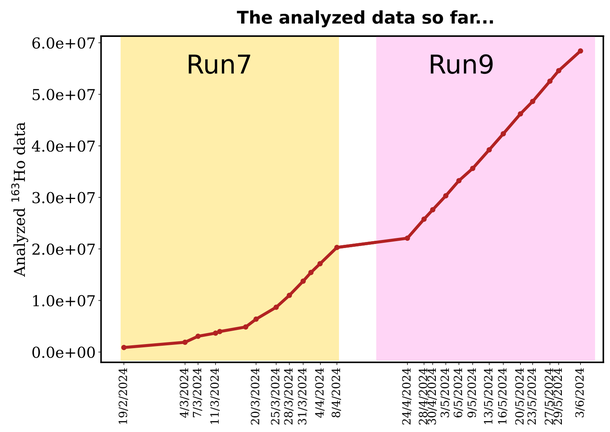
- The 163Ho is embedded inside the detectors.



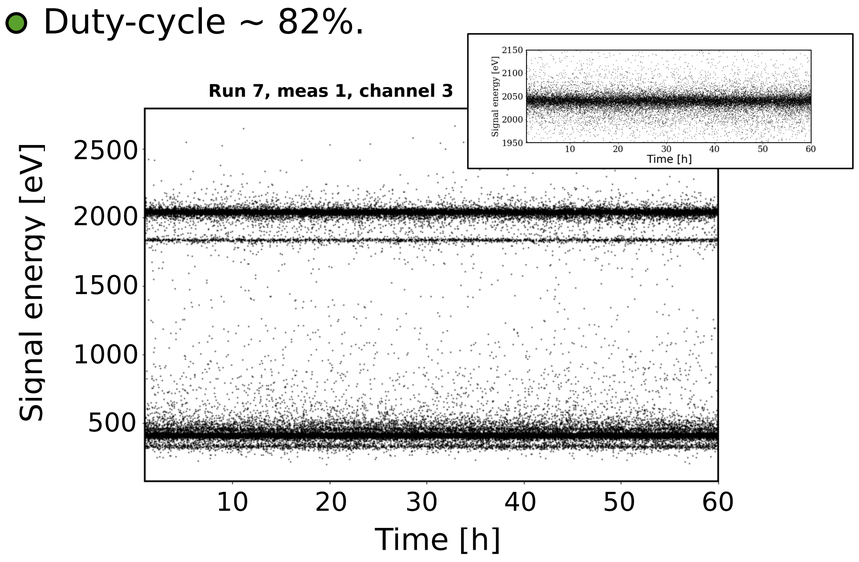

**52 detectors measured**
Mean activity ~ 0.3 Bq
**Total activity ~ 15 Bq**



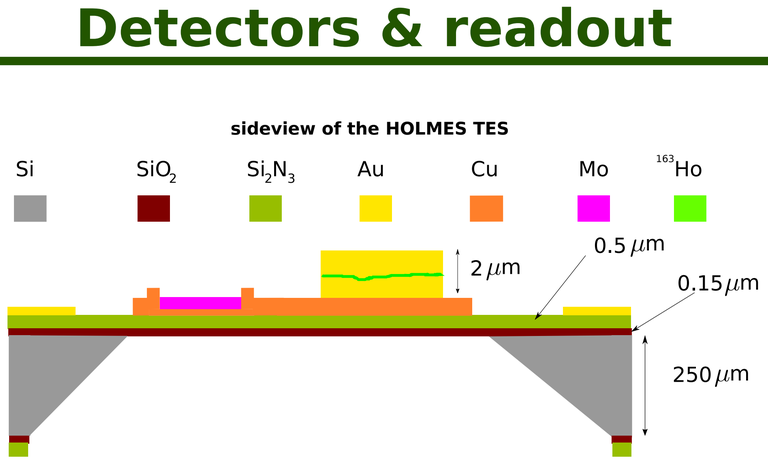

## Data

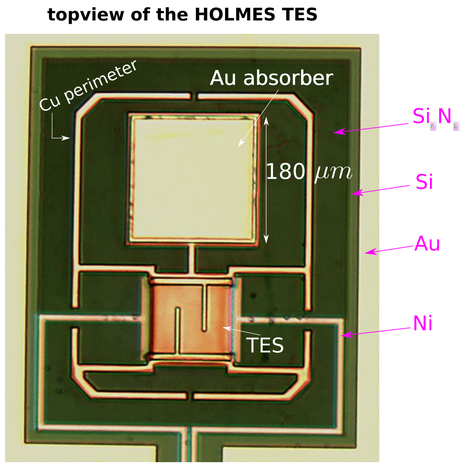



- **60M events** recorded & processed with our analysis software.
- Duty-cycle ~ 82%.




## Detectors & readout



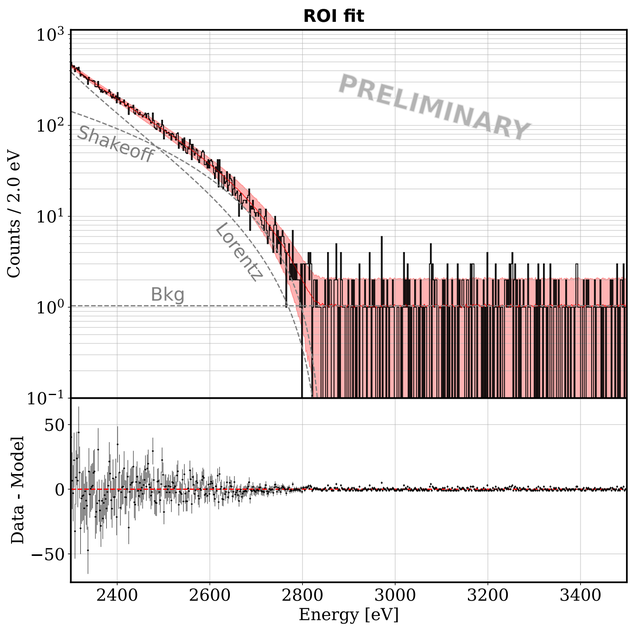

- **Transition edge sensors (TES).**

  Critical temperature ~ 100 mK
  $\Delta E$ (w/o 163Ho) ~ 4 eV @ 6keV
  Rise time ~ 20 $\mu$s
  Decay time ~600 $\mu$s

- **Microwave multiplexing readout.**

  multiplexing factor ~ 256
  maximum sampling time = 2 $\mu$s

## Preliminary neutrino mass limit




- Simplified model for the ROI.
- Uninformative priors.