

A LIQUID HYDROGEN TARGET FOR THE CALIBRATION OF THE MEG-II LXE CALORIMETER



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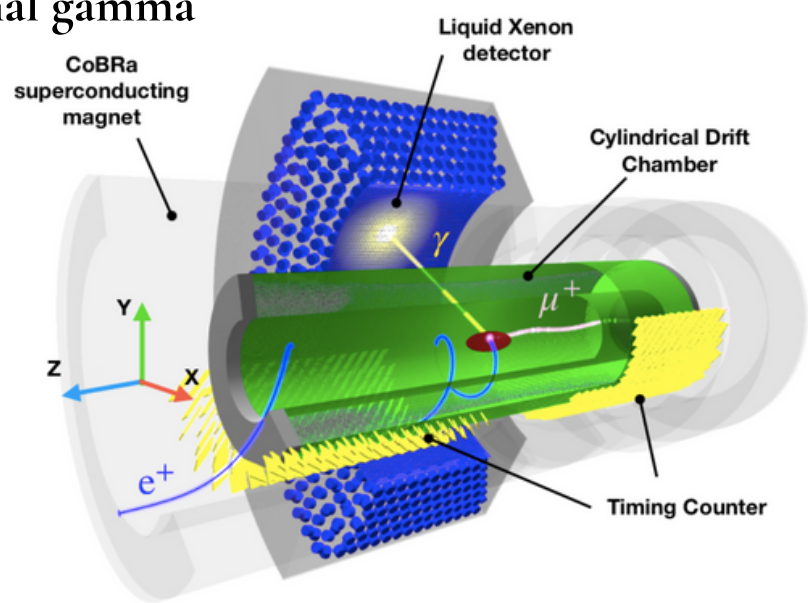


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THE MEG-II EXPERIMENT

- the MEG-II experiment [1,2] searches for the so far unobserved charged lepton flavour violating decay $\mu^+ \rightarrow e^+ \gamma$ with a sensitivity close to 6×10^{-14} on its branching ratio
- it makes use of a **1000 L** liquid xenon C-shaped tank equipped with PMTs and SiPMs to collect the Vacuum UltraViolet scintillation light from the **52.8 MeV signal gamma**
- a Charge EXchange (CEX) reaction is performed yearly to extract the detector performances with **photons at 55 MeV**, close to the signal gamma's energy



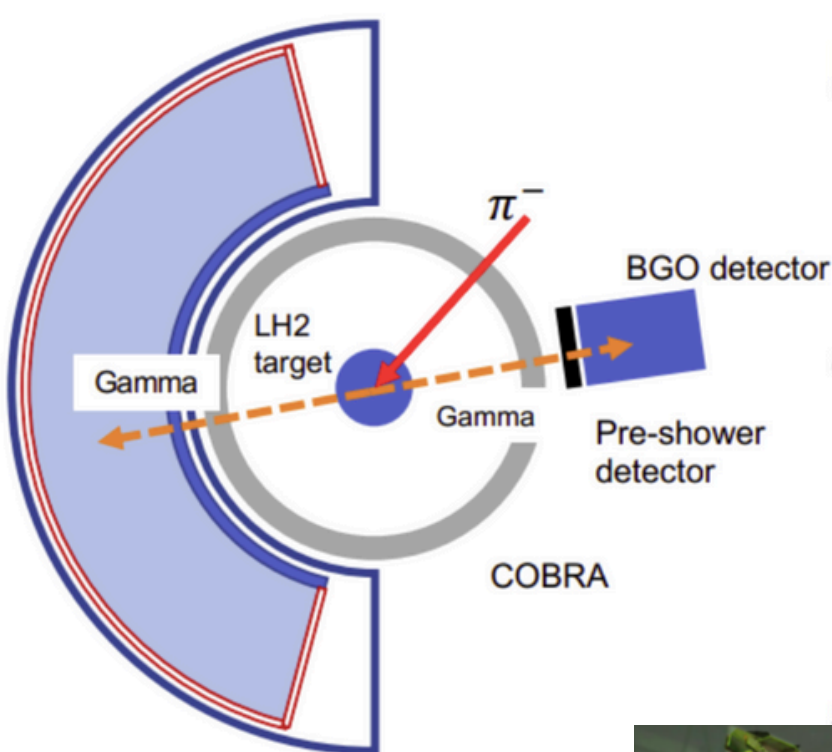
THE LH2 TARGET AND ITS PERFORMANCES

How to bring a cell with LH2 < 20K at the center of 2m-long cylindrical design?

- A closed-volume hydrogen circuit: a buffer of GH2 liquefies to **target cell** at COBRA center 2 meters away
- A flux of LHe goes through a **Cu coil** and cools down a **Cu cold finger holding the cell** through optimized thermal contact
- Vacuum insulation and super-insulating foils
- A pressure and temperature slow-control system

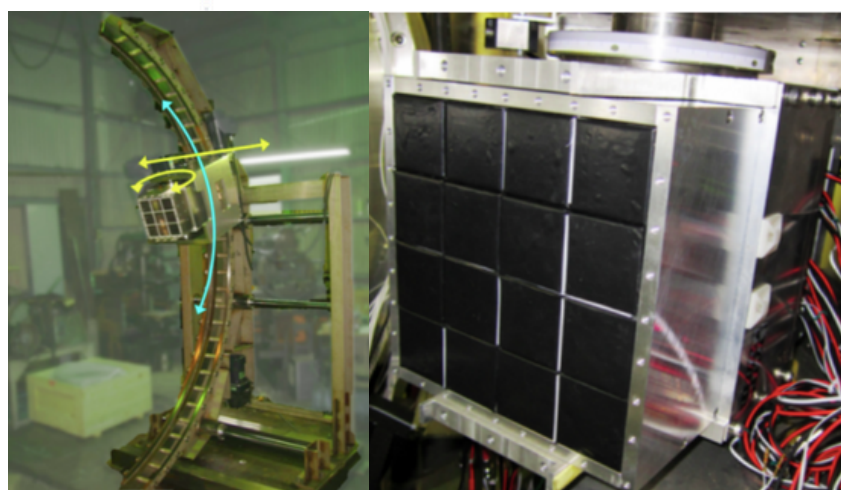


THE CEX REACTION $\pi^- p \rightarrow \pi^0 n, \pi^0 \rightarrow \gamma\gamma$



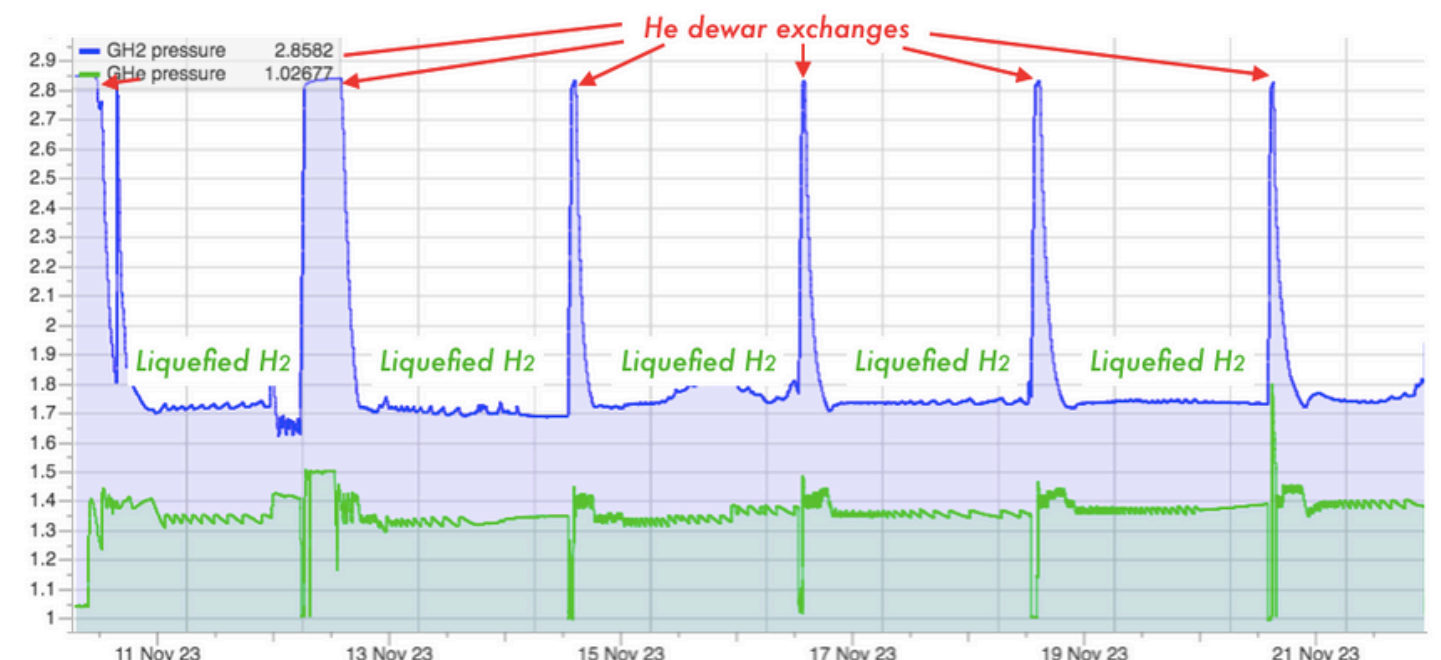
- Negative pions beam onto a LH2 target
- $54.9 < E_\gamma < 82.9$ MeV
- 55 MeV gammas selected through back-to-back $\Upsilon\Upsilon$ topology request making use of a 4x4 BGO crystals array

- BGO is moved along the longitudinal and azimuthal directions to **match the 24 patches** of the xenon volume



Performances

- LHe consumption: 250 liters / 24 hours
- Despite finite LHe dewars: **80% live time** for CEX



THE XENON DETECTOR PERFORMANCES

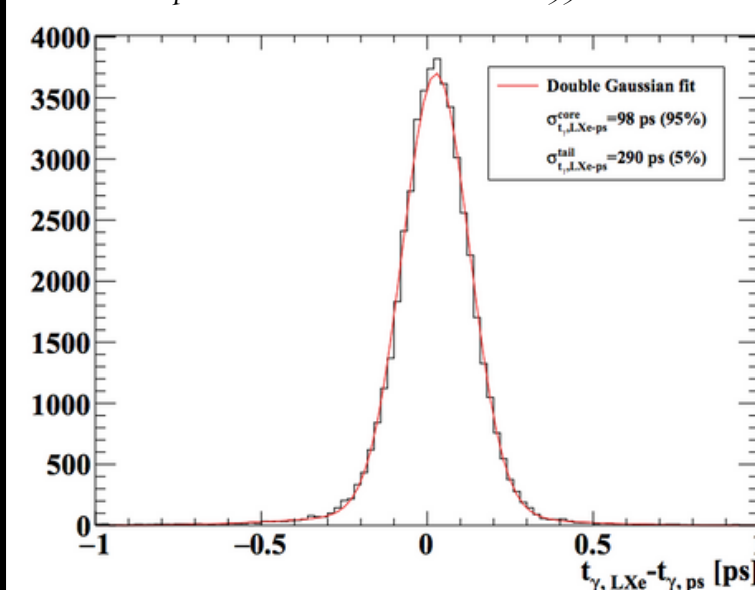
Data collected with the LXe calorimeter through the CEX reaction allow an estimate of its performances:

- the **time resolution** is extracted by measuring the time difference between the two photons in the xenon and a pre-shower (front of BGO)

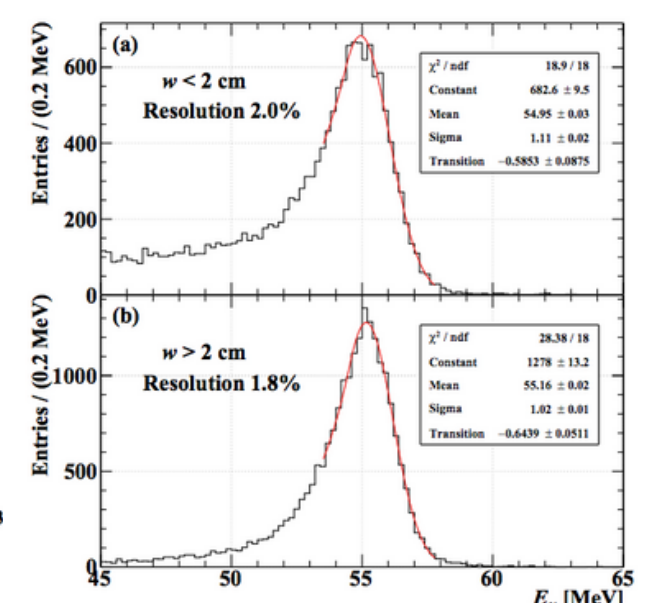
$$\sigma_{t_{\gamma, \text{LXe}}} = 65 \pm 6 \text{ ps at } E_\gamma = 55 \text{ MeV}$$

- the **energy resolution** through a fit of the energy spectrum in a central region of the detector

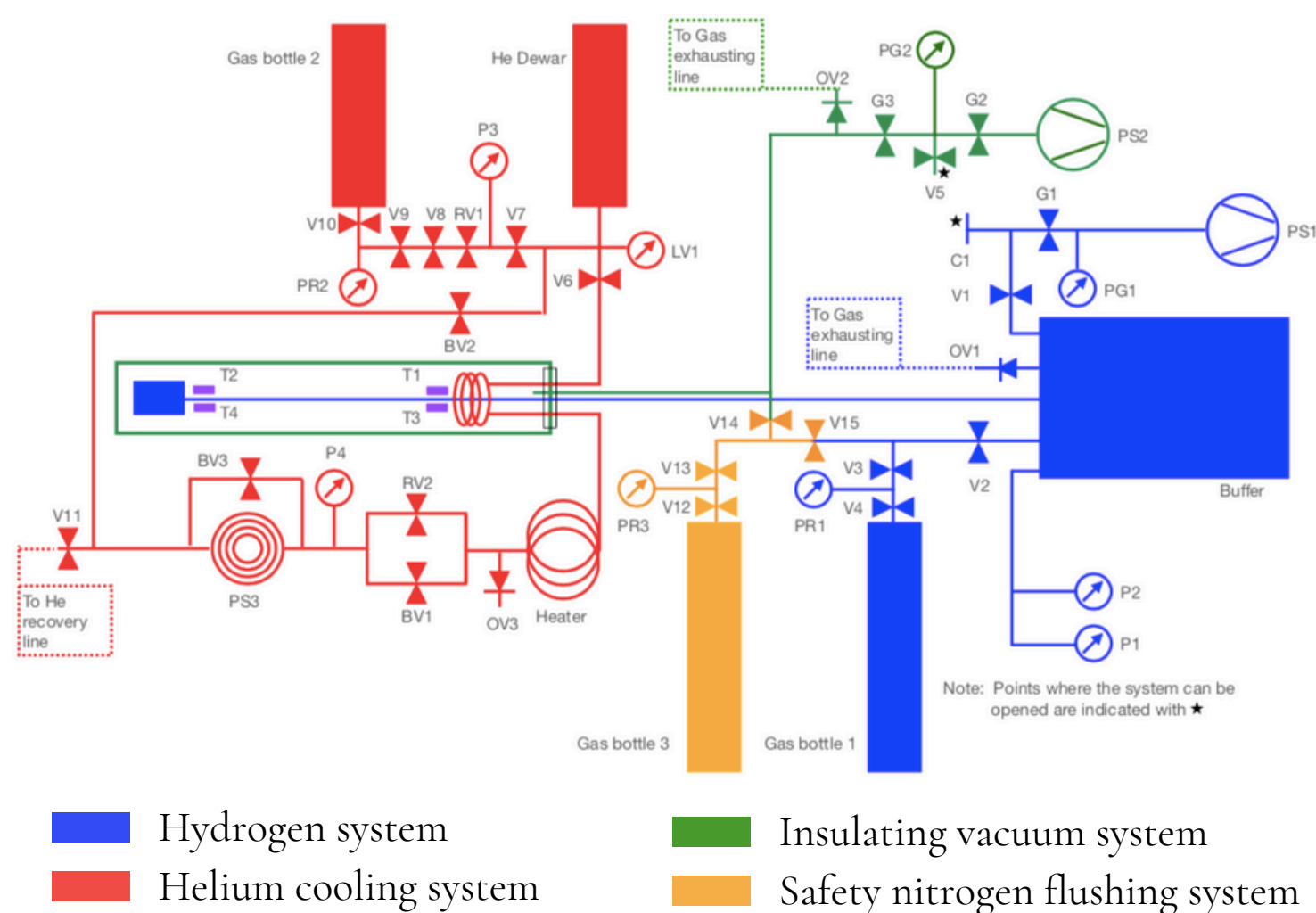
Time difference between the reconstructed photon timing in LXe detector and that on the pre-shower counter at $E = 55$ MeV



Energy response to 55 MeV photons hitting the LXe detector based on depth w



THE LH2 TARGET CIRCUIT



REFERENCES

- [1] A. M. Baldini et al. "The design of the MEG II experiment". EPJC, 78(5) (2018)
 [2] K. Afanaciev et al. "Operation and performance of the MEG II detector". EPJC 84(2) (2024)