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A liquid hydrogen target for the calibration of the MEG and MEG-II liquid xenon calorimeter

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The liquid xenon calorimeter of the MEG experiment at PSI is designed to have a percent-level resolution at a photon energy of 52.8 MeV. To measure its performance, stability and uniformity it is mandatory to have a calibration source as close as possible to this energy.

The charge exchange reaction of negative pions at rest on protons produces both mono-energetic 129~MeV photons and a flat spectrum from 55 to 83 MeV coming from the decay of the daughter neutral pions. With the aid of an opposite-side detector it is possible to tag almost monoenergetic 55~MeV photons impinging on the xenon detector.

A fundamental device in this respect is the proton target to be placed at the center of the MEG experiment. Its design is non trivial since it has to be suspended at the center of a 3m long magnet, with a strong magnetic field and limited accessibility.

We designed and operated a liquid hydrogen target that was used along the entire MEG data taking (2008-2013) to perform such a calibration. The hydrogen is liquefied by means of a continuous LHe flow in a 75cc cell made of stainless steel equipped with a thin mylar window to minimize the material along the π^- trajectory.

We describe, along with the obtained results on the detector resolution, its reliable and cost-effective design, its operation and the modifications needed to adapt the existing target for the calibrations of the liquid xenon calorimeter in the MEG-II upgrade (2015-2019).

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