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

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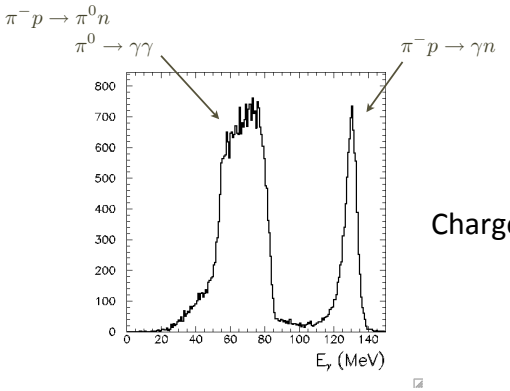
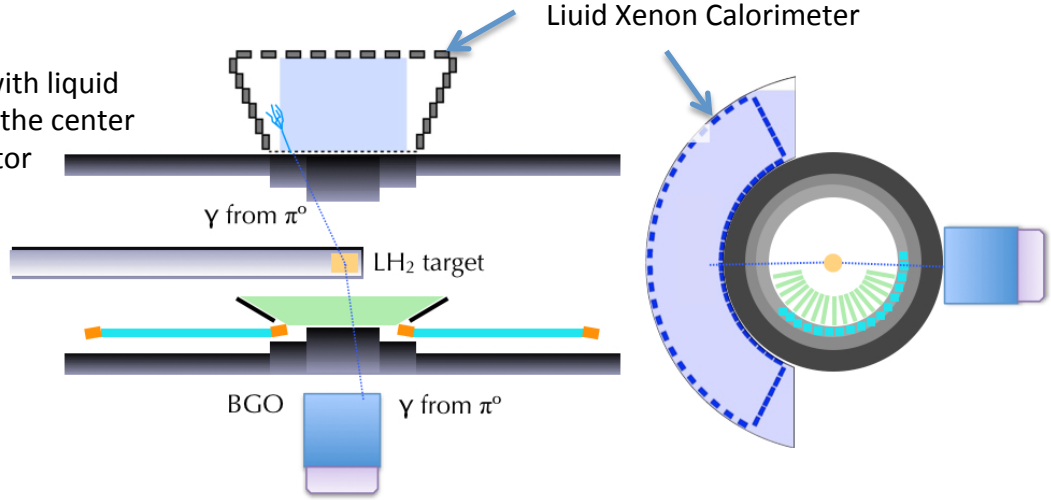
We designed, constructed and operated a liquid hydrogen target for the calibration of the liquid xenon calorimeter of the MEG experiment. The target was used throughout the entire data taking period, from 2008 to 2013 and it's being refurbished and partly re-designed to be integrated and used in the MEG-II experiment.

The charge exchange (CEX) reaction $\pi^- p \rightarrow \pi^0 n$ produces calibration photons from the neutral pion decay in the energy range 55 MeV < E_γ < 83 MeV very close to the $\mu \rightarrow e\,\gamma$ photon energy.



Charge exchange spectrum

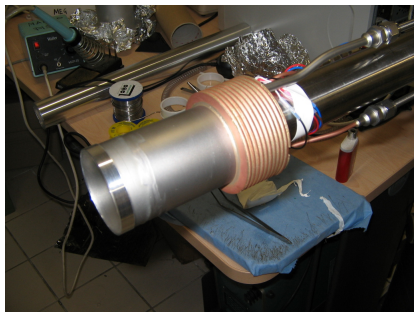
MEG CEX set-up with liquid hydrogen target at the center f the detector



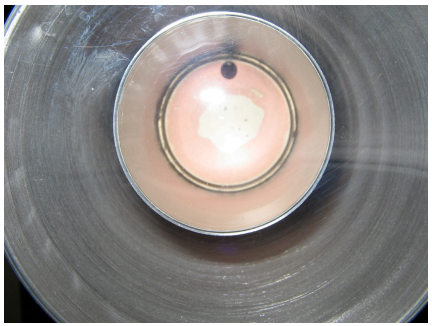
Need for a custom liquid hydrogen target with:

- Cell at the center of a solenoid magnet with high magnetic field (1.4 T)
- short data taking interruption (max beam time)
- Quick preparation: mounting, liquefaction, evaporation
- Accessibility to the operating position
- Minimal material towards the calorimeter
- Thin windows

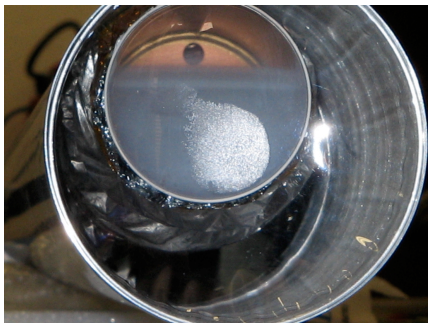
The liquid hydrogen cell is a 500 um thick stainless steel cell 75 mm long and 50 cm diameter (150 cc liquid) cooled by a copper coil by a continuous flux of liquid helium. The entrance window is made of a 135 µm mylar foil glued to the target cylinder by a two components fast setting epoxy resin. The target cell is suspended by a 2 m long non-magnetic stainless steel pipe to be placed at the nominal center of the MEG-MEGII detector



The liquid hydrogen cell

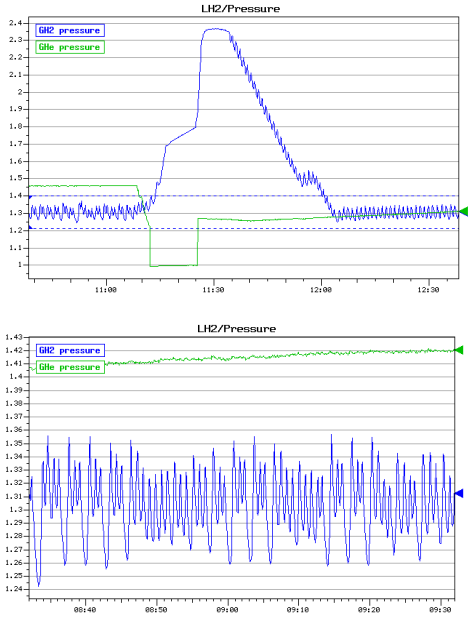


Empty cell before liquefaction. The hydrogen gas inlet is visible



The cell in operating conditions is full of liquid hydrogen

In 50 minutes the target is ready for operation and its pressure/volume is stable at the percent level. Liquid He consumption is roughly 3 liters per hour



The liquid hydrogen was operated for the calibrations of the MEG experiment during years 2008-2013 against a BGO crystal and allowed the precise determination of the energy and timing response of the liquid xenon detecto

Plot of the energy of back-to-back photons as observed by the MEG liquid xenon detector against a calibration BGO detector.