

Test of the MINOS liquid H₂ target at RIBF

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MINOS (acronym for MagIc Numbers Off Stability) is a device dedicated to perform the spectroscopy of highly exotic nuclei produced at fragmentation facilities such as the RIBF accelerator of RIKEN. The device^{1,2)} consists of a thick liquid H₂ target (50–200 mm) surrounded by a time projection chamber (TPC) used to track the vertex position inside the target. The advantage of using such a thick H₂ target is twofold: it increases the luminosity and minimizes the energy loss and straggling of the beam. Furthermore, the use of a structureless probe allows an accurate theoretical description of the reaction mechanism. The vertex information obtained from the TPC helps in preserving the experimental resolution.

The target was developed at the Accelerator, Cryogenics and Magnetism Division - CEA Saclay. The liquid H₂ is contained in a Mylar envelope less than 150 μm thick, composed of two parts glued on an Inox support connected to the H₂ circuit. The target is connected to the cryostat (Fig. 1) equipped with a cryocooler, allowing to reach the liquefaction temperature of 20.3 K. Within the cryostat, the condenser connected to the cold head cools down the H₂ that is transferred by gravity to the target (Fig. 2). This system works in a close loop allowing to minimize the amount of H₂ to be used. A specificity of this system is the possibility to empty the target in less than 30 s. This can be attained by closing a valve on the return circuit, thence producing an overpressure that pushes the liquid to the condenser situated 1 m above. The target can be kept empty for up to 10 h and filled again in 20 s by opening the valve. This functionality allows to easily perform a measurement of the background due to reactions of the beam on the Mylar envelope. Installation and dismounting of the system take 3 and 1 d, respectively. The system was tested successfully at the RIBF facility in July 2013. A full operation cycle was performed in 72 h: H₂ liquefaction and filling of the target, a demonstration of the “empty target” functionality, H₂ evaporation, and emptying of the target. The liquid H₂ target is expected to be used, coupled with the MINOS detection system, to perform physics experiments at RIBF from Spring 2014.

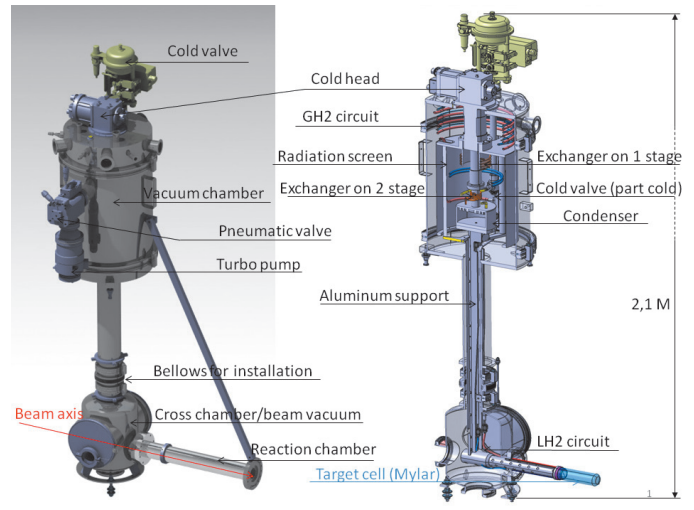


Fig. 1. Schematic view of the cryostat.

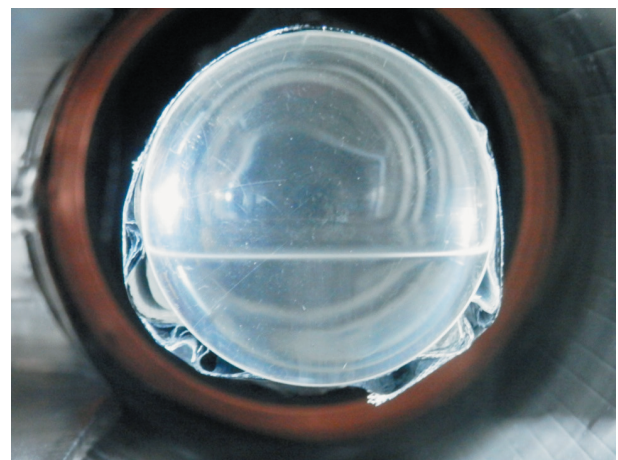


Fig. 2. Front view of the target being filled with liquid H₂.

References

- 1) A. Obertelli, proceedings in French-Japanese Symposium on Nuclear Structure Problems, Ed. by H. Otsu, T. Motobayashi, P. Roussel-Chomaz and T. Otsuka (2012).
- 2) A. Obertelli *et al.*, accepted in Eur. Phys. Jour. A (2014).

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