

# CRYOGENIC TARGETS OF THE LIGHTEST GASES (HYDROGEN, DEUTERIUM AND HELIUM-4) WITH GM CRYOCOOLER FOR EXPERIMENTS OF HIGH ENERGY PHYSICS

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Researches of collision processes of elementary nuclei on the extracted beams of the NICA accelerator complex by the BM@N physics installation need cryogenic targets with unique ratios between the amounts of working substance (liquid hydrogen, deuterium or helium) and the mass of the target's housing, which may have the interaction with an ion beam, result the secondary particles, and initiate the background events. The first part of the article describe the well-known method of cooling the cryogenic targets with polymeric housing by liquid helium and experimental data on the permeability and strength of various materials at low temperatures, as well as starting and operating parameters are given. The installations created according to this method and based on such targets have proven themselves well when working in many accelerator sessions. An exceptional feature of these installations is the double helium heat exchange condenser. In the second part of the article an updated method of cryogenic targets cooling by using the GM cryocooler is given. A maximum cooling capacity of GM cryocooler is 1.5 watts at 4.2 Kelvin, which looks acceptable for such application. The using of GM cryocooler allows creating a fully autonomous and mobile cryogenic target, which not depends from outside cold source. Authors put attention on a serious problem of heat leakage, including heat gain from radiation at a maximum beam intensity of  $10^{11}$  particles / s, and propose using cryocooler's refrigeration power to prevent it. Also, in article the influence of magnetic field with intensity up to 1 Tesla on the operation of the cryocooler is discussed.

## Summary

Key words: NICA collider, BM@N experiment, Nuclotron accelerator complex, cryogenic target, cryorefrigerator, liquid hydrogen, liquid deuterium, liquid helium, particle beams, Short-Range Correlation, SRC, high energy physics

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