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Cold moderators for the High Brilliance Neutron Source

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Long-wavelength neutrons for the investigation of nano-scale materials are an indispensable tool in neutron research. With the decommissioning of several European nuclear research reactors in recent times compact accelerator-driven neutron sources (CANS) are of interest in providing scientists with the necessary capacity of neutrons to conduct experiments.

At the *High Brilliance Neutron Source* (HBS) project, multiple cold moderators will be positioned inside the same Target-Moderator-Reflector unit (TMR), each providing its own instrument with cold or even very cold neutrons. All of these moderators can therefore be optimized in terms of material, operating temperature and geometry, depending on the requirements of the instrument.

In a first approach, two cryogenic moderator systems for a prototype TMR have been designed and are currently being manufactured at Forschungszentrum Jülich. While one is a closed-cycle liquid parahydrogen system, the other one allows the batch-wise production of solid moderators, e. g. frozen methane. Both moderators are positioned as close to the target as possible by using so-called *moderator plugs* (MPs). These consist of a vacuum-insulated cryostat with a detachable fluid transfer and moderator section, a neutron guide and surrounding radiation shielding.

The planned operation of these cryogenic moderator prototypes from summer 2022 will enable the experimental investigation of different cold moderator geometries, as well as various options for the surrounding thermal moderator and reflector. The obtained results can then be used to validate and complement nuclear simulations, proof efficient operation and will allow more reliable future designs of such cold neutron sources.