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New Design of a Compact Cryogenic Neutron Moderator

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Abstract

In this contribution we discuss some basic concepts related to the design of a compact cold neutron moderator, intended to operate at a pulsed neutron source. These concepts include the integral view of the cryogenic systems in terms of the synergic performance of its premoderating, moderating and reflecting capabilities, as well as the use of different materials to realize those functions for long wavelength neutrons. The advantages of solid mesitylene* as a high proton density, radiation resistant material have been already exploited at the cold neutron moderator complex of the new IBR-2M reactor, and its capacity to produce tunable emerging neutron spectra as a function of its wide range of temperatures within that phase, make this material a good choice to act as a premoderator in our new design optimization process. We performed parametric studies on the performance of the new concept, by varying shapes, sizes and premoderator temperature of the assembly, through Monte Carlo calculations based on well tested cross section libraries for the materials involved. Brilliance comparisons are presented with existing cold neutron moderators operating or proposed at long pulse neutron sources. When a relatively small volume cold source is demanded, it is found that a configuration based on a solid mesitylene premoderator and a para-hydrogen moderator produces a very intense cold neutron flux. On account of its behavior as a function of energy, the cross section of solid mesitylene supports the expectation for this material to serve as an excellent premoderator and postreflector for long wavelength neutrons. The well established option of liquid deuterium to produce intense beams of cold neutrons whenever enough room is available to accommodate the required volume, is also explored in this study.

* Or a mixture of mesitylene and toluene.