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A New Method to Increase the Cold Neutron Production in Liquid p-H2 Moderators

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Historically, the cold moderators first operating in neutron sources were liquid hydrogen and solid methane at temperatures near 20 K. Even today a preferred option for accelerator-based cold neutron sources is liquid para-hydrogen, because it is not subject to polymerization due to radiolysis, as in the case of hydrocarbon moderators. An extensive amount of information has been produced for that material on cross sections, and on emission spectra, pulse widths, and the effect of premoderators for different target/moderator/reflector configurations.

A particular neutronic property of liquid hydrogen at 20 K is reflected by the mean-free path of neutrons, where values of approximately 12 cm for the pure para species correspond to neutrons between 1 and 10 meV. This fact, together with a mean-free path of approximately 1.4 cm for thermal neutrons, is the basis for the low-dimensional concept for increasing the cold neutron brightness of para-H2 moderators. Such concept either for flat or tube moderators has dictated the configurations adopted by almost all new projects using liquid hydrogen cold neutron sources.

In this work a new method is presented to further increase the cold neutron production using p-H2 in different configurations, by exploiting the changes in the parent flux spectra created by different premoderator temperatures and their effects on the emitted cold flux. Simulations on simple premoderator/moderator conditions aimed at confirming the actuality of the method and the magnitude of the gains are shown.

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Cold Moderators and Beyond

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