Ultra-cold neutron sources: UCN production rate at solid deuterium converter

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Abstract
A new model is presented herein to calculate optimal value for ultra-cold neutron (UCN) production rate of a UCN source. The cold neutron (CN) converter is the main component of UCN source. In this paper, we study the UCN source which contains the D2O neutron moderator, the sD2 converter, 590 Mev proton beam, and the spallation target (a mixture of Pb, D2O and Zr). In order to determine the quantities, the neutron transport equation, written in MATLAB, has been combined with the MCNPX simulation code. The neutron transport equation in cylindrical coordinate has been solved everywhere in sD2 by using simulated CN flux as boundary value. By loading a cylindrical shell with different materials, surrounding the converter, different values for UCN production rate and density were obtained. The results of the UCN production rate and density and their comparison with previous results show that the present method has a good capability for optimization of UCN source parameters.

Keywords: converter length, cylindrical shell, MCNPX simulation code, neutron transport, ultra-cold neutron production rate

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