

Conceptual Design of an Ultra-Cold Neutron Source based on beamline 12 at China Spallation Neutron Source

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Abstract: UCNs have wide applications in fundamental physics and condensed matter physics, such as measuring neutron electric dipole moment, neutron lifetime, precise measurement of Earth's gravity, and measuring the dynamics of large biomolecules. We plan to construct a superfluid helium based ultra-cold neutron (UCN) source (Beamline 12B, i.e. BL12B) in 2024 at China Spallation Neutron Source (CSNS). This report presents the fundamental physics and simulation process of the ultra-cold neutron source design firstly. To optimize UCN source, the key factors affecting the neutronic parameters of UCN source are discussed then. For CSNS-BL12B, the number of cold neutrons fed into the UCN source and UCN storage lifetime are the two most important parameters, which influence the UCN production rate, density, quantity, saturated density, and UCN number at exit. Finally, the time structure and physical conceptual design of UCN source at the CSNS are presented.