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On an alternative neutron source

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Traditional point sources of neutrons produce free neutrons in isotropic directions and with kinetic energy in the MeV energy domain. These neutrons are too fast for many applications as the probability of interaction between neutrons and surrounding matter is often higher at low neutron energies. Therefore, to optimize interaction between neutrons and its environment, these neutrons are slowed down in the eV or meV energy domain with a moderator.
This presentation describes a novel method for neutron moderation from an isotropic source by utilizing a rotating moderator to provide a versatile source of neutrons. The source of primary neutrons, the rotation speed of the moderator, the physical properties of the moderator and neutron scattering instruments surrounding the moderator are all adjustable parameters impacting the final neutron spectrum. A GEANT4 (toolkit for the simulation of the passage of particles through matter) simulation was built and shows that this rotating neutron moderator can partially focus neutrons in space; neutrons are emitted preferentially in the rotation plane, but throughout the longitudinal domain because of its circular configuration. To further increase neutron flux, it is desirable to consolidate the emitting neutrons to a narrower longitudinal domain. Fortunately, the direction of emission of the neutrons, relative to the moderator, is known as it depends on the rotation speed. This important detail allows use of neutron supermirrors to achieve longitudinal consolidation, since alignment of supermirrors requires accurate control. Therefore, McStas (Monte Carlo code) was used to evaluate the possibility of using supermirrors to collect neutrons from the rotating moderator into a beam. Unfortunately, constructing such a device is limited by material strength to withstand the rotational forces and temperatures required.

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