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A new method to find out the optimal neutron moderator size based on neutron scattering instrument parameters

In the last decade, low-dimensional neutron moderators made from almost pure para-hydrogen (pH2) have been introduced [1]. Thanks to large difference in pH2 scattering cross-section between thermal and cold neutrons, moderators in the form of tubes or disks provide significant brightness improvements over traditional cold sources. According to a study by the ESS [2], potential gains of up to 2-3 times in the useful neutron flux are possible when the moderator height is reduced from 12 cm to 3 cm, especially for high-resolution instruments that use well-collimated beams. However, the small size of the moderators in some cases makes it difficult to fully illuminate the sample, leading to non-uniform beam profiles at the sample. Therefore, larger neutron moderators with reduced brightness are preferred for some instruments.
To determine the optimal moderator size, we have developed a new approach that takes into account instrument parameters such as sample size and angular resolution. It is based on phase space considerations and extensive Monte Carlo simulations have been conducted to validate it. This method is particularly useful for designing new neutron instruments and neutron sources.

1. K. Batkov et al 2013 NIM A729 500-505.
2. L. Zanini et al 2018 J. Phys.: Conf. Ser. 1021 012066.

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