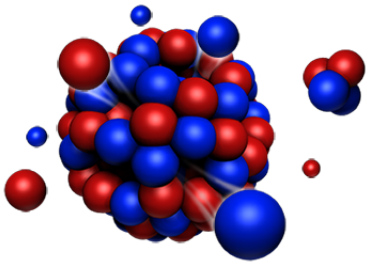

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Moderator Performance at SNS Next Generation IRP (IRP3)

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At SNS the moderators and reflectors are integrated into one component called inner reflector plug (IRP), which essentially delivers desired neutron pulses to all the instruments. The current IRP is operated at a beam power up to 1.4 MW and has an estimated lifetime of ~28 GWhr. The design for the next generation IRP (IRP3) has already been completed. While the main purpose of the design is to reduce the manufacturing difficulty and cost and to improve the operation stability and lifetime, its impacts on the moderator performance is also notable and worthy to be investigated. For improved efficiency and accuracy, a CAD model enabled Monte Carlo simulation method was adopted for this study, where DAGMC was used to track particle transport directly in a CAD model. However, it still requires significant efforts in revising and fixing a designing CAD model to make it compatible to DAGMC. In extending the IRP lifetime from ~28 GWhr to ~35 GWhr, the poison plate thickness was increased by 30% in the water moderator at a penalty of ~3% moderator performance. Nevertheless, with the increase of poison depth on the thin side of the moderator, it sees ~4% gain in the peak pulse intensity on both sides of the moderator and ~ 10% gain in the time-averaged intensity on the thin side. For the hydrogen moderators, their performance is mostly impacted by the thickness change of the moderator vessel boundaries, due to which the decoupled hydrogen moderator suffers ~2% drop of performance while the coupled moderators gains up ~10%. Other aspects of IRP3 design change on the moderator performance were also investigated.

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