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Design Improvements to the SNS Ion Source and Diagnostics

The U.S. Spallation Neutron Source (SNS) is a state-of-the-art neutron scattering facility delivering the world's most intense pulsed neutron beams to a wide array of instruments which are used to conduct investigations in many fields of science and engineering. Neutrons are produced by spallation reactions within a liquid Hg target bombarded by protons from a storage ring that is supplied by a high-intensity, 1 GeV H- LINAC. The LINAC is, in turn, fed by an RF-driven, multicusp, H- ion source which provides 50-60 mA of ions with a pulse width of 1ms and repetition rate of 60Hz (6% duty-factor) for maintenance-free runs of several months with near 100% availability. The ion source research and development program at ORNL has played a key role in enabling and supporting this success and continues to provide sufficient beam current margin for future facility upgrades. This report provides a discussion of ongoing design work which has been undertaken since the previous ICIS conference in 2021. These include (i) mechanical modifications to the source outlet aperture size which resulted in dramatically increased beam current from the source, (ii) refinement of the SNS Allison emittance scanner that has enabled LEBT beam measurements at full beam power, (iii) modelling-driven improvements to the LEBT chopper target which should enable full beam-blanking during routine operations, (iv) the design and initial data from a thermal imaging system for the electrostatic Low Energy Beam Transport (LEBT) that tracks lens temperatures during routine operations allowing early intervention before thermal runaway and finally, (v) the design of an advanced elemental Cs system capable of more precise control of source cesiations compared with the Cs2CrO4 system.

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