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Comparative Study of CW and Pulsed 13 MHz vs 27 MHz RF Plasma Ignition Systems for H⁻ Ion Source Operation at SNS

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This paper presents a planned comparative study of RF plasma ignition systems operating at 13 MHz and 27 MHz in both continuous wave (CW) and pulsed modes for H⁻ ion sources at the Spallation Neutron Source (SNS). The objective is to evaluate how RF frequency and mode influence plasma ignition characteristics and system performance. Key parameters to be characterized include RF power requirements, H_2 gas flow rates, antenna current, pulse duration, and timing overlap between the RF ignition pulse and the main 2 MHz high-power pulse. Experiments will be carried out on the Ion Source Test Stand (ISTS) to assess performance under both CW and pulsed conditions.

A secondary focus is the characterization of dark current—residual H⁻ beam current observed during 13 MHz CW operation when the main beam pulse is off. This current is presently directed into the first drift tube linac (DTL1) during maintenance operations. The study will investigate whether pulsed RF operation at either frequency reduces or eliminates this effect.

Findings from this study are expected to guide improvements in plasma ignition reliability, reduction of unintended beam current during standby periods, and optimization of RF system configurations for ion source applications at SNS.

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