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Implementation of a temperature and density monitoring diagnostic for the LANSCE negative ion source

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We report on adding a mutiwavelength emission and absorption diagnostic to the Los Alamos Neutron Science Center (LANSCE) H^- ion source. The LANSCE H^- ion source is a filament/arc driven, multi-cusp, surface conversion based system. Historical trends for setting runtime parameters and user "know-how" are the primary tools for tuning and running the ion source. In this work we are better quantifying our runtime and source recycle processes. The LANSCE source is used in repeated four-week run cycles during the annual six-month run period. Here, we test the hypothesis that real-time monitoring of the plasma temperature and cesium density will provide feedback information to increase run cycle time, optimize H^- current, and monitor the source's health. To this end, we have installed a dual wavelength tunable laser diode absorption spectroscopy (TLDS) system with fiber transport for monitoring the H_α Balmer line absorption strength of excited state hydrogen ($H_{n=2} \rightarrow H_{n=3}$ transition) at 656.3 nm and the D_2 absorption line of cesium at 852.3 nm. Our optical measurement and fiber transport to/from the active source provides a non-intrusive method for extracting data from the source's 750 kV high voltage environment. Simultaneous collection of TLDS absorption, and emission lines from the H_β and H_γ excited states are incorporated into the data collection scheme with a series of narrow-band dichroic mirrors. Our design of a sweeping TLDS allows for collection of emission and absorption data within the same sub-millisecond plasma arc pulse, and the combination of these measurements allows us to monitor the generating hydrogen plasma temperature and cesium density during ion source conditioning and operations. In addition to the system design, we will present our initial data on monitoring production run sources, and we will evaluate the future impact of these measurements on overall system efficiency.

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