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CANS at BNL

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Brookhaven National Laboratory (BNL) has a long history of neutron-related research, including early experiments using reactor-based neutron sources for Boron Neutron Capture Therapy (BNCT) dating back to the 1950s. Beginning in the 1990s, various Compact Accelerator-driven Neutron Source (CANS) concepts were explored. However, these activities ceased entirely around the turn of the millennium and remained dormant for two decades.

Recently, we have successfully accelerated a highly intense lithium beam using a laser ion source and Direct Plasma Injection Scheme (DPIS) technology. Building on this achievement, our team has initiated a renewed effort to establish a new CANS facility at BNL. Official recognition of this project within the laboratory was granted in 2023, and we have since commenced a detailed feasibility study.

Unlike most current or planned CANS facilities, which typically accelerate protons to produce neutrons from lithium or beryllium targets, our approach involves bombarding a hydrogen target with a lithium beam. This inverse kinematics scheme offers distinct advantages. While the lithium beam requires a threshold energy of around 13 MeV to generate neutrons, we plan to operate at approximately 15–16 MeV. Although this energy appears higher than those commonly used for proton beams, the total accelerating potential required is only about 5 MV because the lithium ions are triply charged. This is actually lower than the voltages typically employed in proton-based systems using beryllium targets.

Currently, we achieve about 40 mA of lithium beam current at the exit of the RFQ (our first-stage RF accelerator). However, since the pulse width is on the order of a few microseconds, we need higher repetition rates to ensure sufficient neutron flux. To meet this requirement, we are considering the use of a liquid lithium target. In parallel, we are developing a linear accelerator to further increase the peak beam current. We are also conducting complementary neutron production experiments using BNL's existing tandem electrostatic accelerator.

At the conference, we will present and discuss the details of our research activities, the design concept of the new CANS facility, and the progress of our ongoing feasibility and construction plans.

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Presenter if not the submitter of this abstract

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Future of CANS

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