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Operational Experience of a High-Intensity Accelerator-based Neutron Source Based on a Liquid-Lithium Target

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A prototype of a compact Liquid Lithium Target (LiLiT), able to constitute an intense accelerator-based neutron source was successfully tested for the first time with an intense 1.9 MeV, 1.3 mA (~2.5 kW) continuous-wave proton beam. The high-power liquid-lithium target is designed to produce neutrons through the 7Li(p,n)7Be reaction and to overcome the major problem of removing the thermal power generated by the proton beam at high intensity (1.91-2.5 MeV, >3 mA). Gold activation targets positioned in the forward direction show that the average neutron intensity during the experiment was ~2×1010 neutrons/s. The device will be used to assess the feasibility of accelerator-based Boron Neutron Capture Therapy (BNCT) with a lithium target and for research in stellar and Big-Bang nucleosynthesis and Accelerator Driven Systems (ADS) material cross section measurements.

The liquid-lithium jet acts both as neutron-producing target and as a beam dump, by removing with fast transport the thermal power generated by high-intensity proton beams. It has been designed to generate a stable lithium jet at high velocity on a concave supporting wall with free surface toward the incident proton beam (up to 10 kW). Of specific concern is the power densities created by the protons at the Bragg peak area, of the order of 1 MW/cm3 (volume power density), about 150 µm deep inside the lithium. Radiological risks due to the 7Be produced in the reaction will be handled though cold trap and appropriate shielding. Fire safety issues are taken care by multiple layers of passive and active safety devices.

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