A high-power Liquid-Lithium Target (LiLiT) for neutron production

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A high-power Liquid-Lithium Target (LiLiT) [1,2] was built and commissioned with a 1.2 mA, 1.91 MeV (2.3 kW) proton beam from the SARAF (Soreq Applied Research Accelerator Facility, Israel). The LiLiT device (Fig. 1) consists of a forced-flown (> 2 m/s) film of liquid lithium (at ~200 ^{o}C) whose free surface is bombarded by the proton beam. The lithium film acts both as a neutron-producing target via the ^{7}Li(*p*,*n*) ^{7}Be reaction and as a power beam dump, dissipating the beam power by transport to a reservoir and heat-exchanger. The target dissipates a peak power areal density of 2.5 kW/cm^2 and a peak volume density of 0.5 MW/cm^3 with no significant temperature, vacuum elevation or evaporation in the vacuum chamber. The SARAF-LiLiT system is used as a high-intensity neutron source with a yield (peaked at ~25 keV) of ~ 2 ×10^{10} n/s, more than one order of magnitude larger than conventional ^{7}Li(*p*,*n*)-based sources. The exposure rate from residual ^{7}Be activity accumulated in the LiLiT loop and reservoir during the experiments was monitored at the end of each run (maximum of 30 μrem/h per 1.2 mA·h on target at 30 cm from the lithium reservoir) and was found consistent with Monte-Carlo simulations assuming homogenous ^{7}Be distribution in lithium. The neutron source is suited for the study of neutron capture reactions on nuclides (stable or radioactive) of low abundance. Preliminary results for the 25-keV Maxwellian-averaged cross sections (MACS) of neutron capture on Zr isotopes were obtained. In a different realm of research, the neutron source is well adapted to the needs of Boron Neutron Capture Therapy (BNCT) and experiments are planned to study the dosimetry in target and colateral tissues and optimize the tailoring of the neutron spectrum.

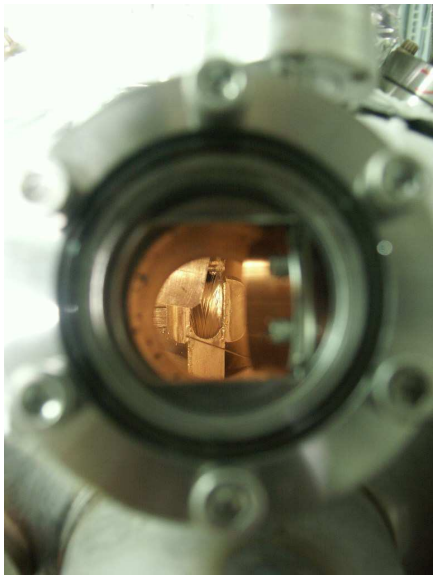

Figure 1: View of the free- surface Liquid-Lithium Target (LiLiT) from the target chamber viewport.

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References:
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[2] S. Halfon *et al*., Rev. Sci. Instr. 85, 056105 (2014)