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The Plasma Window as a Vacuum-Atmosphere Interface for Measurements of Stellar Neutron-Induced Reaction Cross Sections

Neutrons play a dominant role in the stellar nucleosynthesis of heavy elements. We review a scheme for the experimental determinations of neutron-induced reaction cross sections using a high-intensity neutron source based on the 18O(p,n)18F reaction with an 18O-water target at SARAF's upcoming Phase II. The quasi-Maxwellian neutron spectrum with effective thermal energy kT ≈ 5 keV, characteristic of the target (p,n) yield at proton energy Ep ≈ 2.6 MeV close to its neutron threshold, is well suited for laboratory measurements of MACS of neutron-capture reactions, based on activation of targets of astrophysical interest along the s-process path. 18O-water's vapour pressure requires a separation in between the accelerator vacuum and the target chamber. The high-intensity proton beam (in the mA range) of SARAF is incompatible with a solid window in the beam's path. Our suggested solution is the use of a Plasma Window, which is a device that utilizes ionized gas as an interface between vacuum and atmosphere, and is useful for a plethora of applications in science, engineering and medicine. The high power dissipation (few kW) at the target is expected to result in one of the most intense sources of neutrons available at stellar-like energies. Preliminary results concerning proton beam energy loss and heat deposition profiles for target characteristics and design, a new full-scale 3-dimensional computer-aided design model of the Plasma Window (as well as its operation principles) and the planned experimental scheme, will be reviewed.

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