Lithium Granular Injector Operational Experience Triggering ELMs in H-Mode on DIII-D

A. Nagy, A. Bortolon, E. P. Gilson, R. Lunsford, R. Maingi, D.K. Mansfield, A.L. Roquemore
Princeton Plasma Physics Laboratory
Princeton, New Jersey 08543-0451, USA
nagy@fusion.gat.com

C. P. Chrobak, G. L. Jackson
General Atomics
DIII-D
PO Box 85608, San Diego, California 92186-5608, USA

Abstract—An injector device to trigger frequent edge localized modes (ELMs) was developed at Princeton Plasma Physics Laboratory (PPPL) and subsequently installed and operated on DIII-D, to inject lithium spherical granules to launch into tokamak plasmas. One size granule per shot, selectable between shots, of four different spherical lithium granule sizes are available to launch horizontally into the plasma mid-plane at speeds up to 120 m/s. Pre-sorted granules are stored in a 4-chamber reservoir containing granules at various sizes, 900, 700, 500, and 300 micron. A manually controlled gating device opens the subject reservoir compartment channeling granules to a piezo crystal with a central aperture. The disk is then electrically vibrated at its resonant frequency causing granules to fall through the aperture into a vertical tube that terminates slightly above a rotating impeller strike zone. The variable speed rotating impeller, hits the granules through an aperture gated drift tube into the plasma. The 44 cm vertical drop imparts sufficient vertical speed to the granules to reach to the impeller center. A high-speed camera records granule/impeller interaction events to provide the injection count. Another on-axis high-speed camera records the plasma edge ablation events. Impeller speed is monitored via a photodiode using an external illumination system. Initial operations injected granules at frequencies up to 120 Hz (900 micron) and >600 Hz (300 micron). ELM triggering efficiency approached 100% for 700 and 900 micron in ELMing H-mode plasmas. The injector can be used to inject other materials e.g. boron, tungsten, carbon, etc. The system and planned upgrades are discussed.