

Compact Solid-State Neutral Particle Analyzer in Current Mode

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Solid state neutral particle analyzer (ssNPA) arrays are operated in current mode on the DIII-D tokamak and the National Spherical Torus Experiment (NSTX). When compared with conventional pulse-counting NPA operation, current-mode operation sacrifices energy resolution to obtain economical, high-bandwidth, pitch-angle resolved measurements.

At NSTX, the apertures on an existing array [1] were expanded to increase the particle influx. At DIII-D, a new three-channel ssNPA array was installed. The sightlines of both arrays intersect heating beams, enabling both active and passive charge exchange measurements. The three near-vertical viewing chords of the DIII-D array intersect the centerline of the closest near-tangential neutral beam at major radii of 1.50, 1.65, and 1.83 m. The spatial resolution at beam intersection is typically 5 cm on both devices. Directly deposited ultra-thin foils on the detector surface block stray photons below the energy of 1 keV and also bring about a 25 keV low energy threshold for deuterium particle detection. Oscillations in neutral flux produced by high frequency MHD instabilities (e.g. toroidal Alfvén eigenmodes at ~50 kHz) are readily detected.

[1] D. Liu, et al., “Performance of the solid state neutral particle analyzer array on the national spherical torus experiment,” *Rev. Sci. Instrum.* **77** (2006) 10F113.

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