Initial measurements of the beam ion profile in NSTX with the Solid State Neutral Particle Analyzer array

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The Solid State Neutral Particle Analyzer (SSNPA) array on the National Spherical Torus Experiment (NSTX) utilizes silicon diodes coupled to fast digitizers to measure the energy distribution of charge exchange fast neutral particles (35~100 keV) at four fixed tangency radii (60, 90, 100, and 120 cm) to obtain the corresponding beam ion profile. Noise reduction techniques required to operate in the tokamak environment and post-shot pulse height analysis (PHA) methods are described. The results have been compared with those on the scanning E//B type Neutral Particle Analyzer (NPA) and good agreement was achieved. The redistribution and loss of beam ions during MHD activity including sawteeth events and internal reconnection events have been observed.

The initial design of the Solid State Neutral Particle Analyzer (SSNPA) array on the National Spherical Torus Experiment (NSTX) was described in an instruments paper by Shinohara *et al.* [1]. This poster highlighted recent improvements. An improved signal-to-noise ratio is obtained through fast digitization of the signal (Fig. 1). In software, the following algorithm is used to select valid pulses.

1. Find all points below a given threshold.
2. For adjacent points that exceed the threshold, locate the peak of this particular pulse.
3. Find the baseline and pulse height for each individual pulse.
4. After normalization, compare the pulse shape with the model pulse shape. If chi-squared is smaller than a specified value, accept the pulse as valid.

Initial results indicate that the SSNPA array has an energy resolution of ~ 10 keV. The diagnostic is able to detect redistribution of fast ions caused by MHD events.

A paper on recent improvements to the SSNPA diagnostic will be submitted to the Review of Scientific Instruments for inclusion in the proceedings of the 2006 High Temperature Plasma Diagnostics conference.

References

[1] SHINOHARA, K., et al., Rev. Sci. Instrum. **75** (2004) 3640.

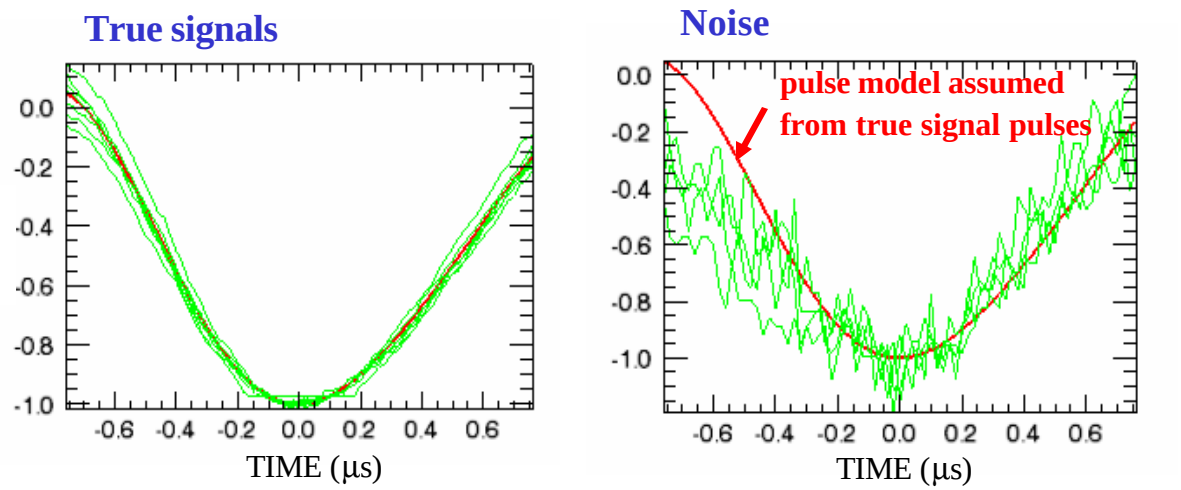

Figure 1. Normalized pulses archived by a fast digitizer. A shaping amplifier determines the pulse shape for true pulses from incident neutrals. Signals dominated by electronic noise deviate from this pulse shape.