Contribution ID: **11** Type: **Short Contributed Oral**

Progress in EAST Neutral Particle Analyzer: INPA and E//B NPA Development for the BEST

A high-performance imaging neutral particle analyzer (INPA) has been developed and installed on the Experimental Advanced Superconducting Tokamak (EAST). Using carbon foils to ionize charge-exchanged neutral particles and scintillator screens to resolve their energy and radial profiles, the INPA's capabilities have been significantly enhanced through multiple upgrades. It functions in both active and passive modes; notably, passive mode signals are also inversely proportional to electron density. Key findings include: the INPA signal's proportionality to neutron yield at constant electron density, successful recording of fast ion redistribution during sawtooth crashes, the distribution of hydrogen fast ion pitch angles accelerated via ICRH up to 100 keV in energy, and observation of an increasing radial gradient in fast ion density during internal transport barrier (ITB) formation—often concurrent with fishbone instability. The model developed based on FIDASIM code has successfully explained the relevant experimental results of INPA data from EAST. Furthermore, an E//B NPA diagnostic has recently been designed for EAST. It is essential for investigating the synergy effect between NBI and ICRH. This diagnostic will also be utilized on BEST, which will be used to monitor Deuterium-Tritium (D-T) burn rates relevant to future fusion reactors.

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Track Classification: withdrawn