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**2-D Real Time Images of Self-Organized $T_e$ Redistribution of Sawtooth Oscillation (m=1 mode) on TEXTOR**[1]

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A novel 2-D Electron Cyclotron Emission Imaging (ECEI) system [1] for measuring electron temperature fluctuations has been applied to study the physics of the sawtooth oscillation (m=1mode) in TEXTOR. The real time 2-D images with high spatial resolution [128 pixels covering 8 cm (radial) x 16 cm (vertical)], and high temporal resolution (up to ∼5 microsec) are ideal for the physics study of complex and multi- dimensional plasma phenomena. The observed 2-D dynamics of $T_e$ fluctuations during the sawtooth period revealed physics information not accessible through conventional methods (1-D ECE and/or X-ray tomography). This paper describes the key technologies for the state-of-the-art diagnostic tool as well as new physics results from TEXTOR sawtooth oscillation studies. The observations revealed that the magnetic field reconnection (puncture) could occur everywhere along the q∼1 surface regardless of whether it is the high or low field side. The measured poloidal extent of the magnetic puncture size is finite and the finite extent of the toroidal magnetic field puncture size has been estimated based on the measured speed of the heat flow and the heat flow pattern from the core to outside of the inversion radius. The physical mechanisms that might be responsible for the magnetic reconnection processes such as stochasticity, fractals, magnetic islands, ballooning modes and pressure driven fluctuations will be discussed. The heat of the m=1 mode transported to the region outside the inversion radius initially follows the local magnetic pitch. Shearless magnetic zone arises from the current sheet [2] may play a role accelerating the heat transport process within the area known as the mixing zone.

[1] H. Park et al., Rev. Sci. Instrum. **75**, 3787 (2004)
[2] H. Soltwisch et al., Plasma Phys. & Control. Fusion **37**, 667 (1995)

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