Two Dimensional Imaging Study of Sawtooth Instability on the HT-7 tokamak

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The sawtooth oscillation was investigated using an electron cyclotron emission imaging (ECEI) diagnostic technique on the HT-7 tokamak. m/n=1/1 and its high-order harmonic modes(m/n=2/2,3/3,...) are observed in sawtooth precursors at the low density plasma. During the sawtooth crash, the reconnection proceeds in two stages. At the first stage, the harmonics cause sharp pressure points, leading to the occurrence of reconnection events and finite openings at more than one place on the q∼1 radius. The openings are not preferential on the low field side. A weak reconnection happens characterized by a slow emergence of a small amount of heat and particles through the finite openings. Subsequently, at the second stage, most of the remaining heat and particles in the core escape outward. The observations at the low density indicate that the harmonics still exist and also responsible for the secondary reconnection stage, which has seldom been mentioned in theoretical reconnection models. A threshold of the density is found, above which the m/n=1/1 mode significantly exceeds its harmonics. The threshold decreases as the edge q value q_a increases. There are many sawteeth during a flat top time of a discharge. The amplitude of the 1/1 mode changes during these sawteeth, which is found coherent to the 3/1 mode occurs at the edge of the plasma.