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Study of the Locked Mode Disruption with the 3-D Imaging Data in KSTAR*

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Discharges on the Korea Superconducting Tokamak Advanced Research (KSTAR) device often have suffered from minor and major disruptions by a large growth of the m/n=2/1 MHD instability. It requires 3-D measurement to decipher the underlying physics of the complicated disruption dynamics. The electron cyclotron emission imaging (ECEI) system on KSTAR is used to measure a quasi 3-D electron temperature (T_e) fluctuations, and the measurements revealed the detailed process of the disruptions from the onset to the explosive growth of the instability.
Onset mechanisms such as the pressure/current profile contraction with density increase and the penetration of the resonant magnetic field perturbation (RMP) are examined by the imaging data.
On the other hand, minor and major disruptions triggered by the naturally formed 2/1 magnetic island have been analyzed in detail and the characteristics of the island growth and electron heat transport are studied. In the KSTAR discharge #8999, three different types of disruptive events were identified during the locked mode phase. They are labelled as the small and large minor disruptions and the major disruption, respectively. The small minor disruption is characterized as a localized heat transport event near the q=2 region with a single 2/1 instability. As for a large minor disruption, the initial 2/1 instability is followed by an additional core instability, which leads to a successive partial relaxation of the region with q<2. During the major disruption, the quasi 3-D imaging data demonstrate one possible mechanism of the explosive growth of the m/n=2/1 magnetic island, i.e. a cold bubble convection. The observed cold bubble and its coupling with the 2/1 island imply that a sufficiently low magnetic shear could be responsible for the explosive growth of the 2/1 island and the major disruption.

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