Observation and Analysis of Resistive Instabilities in Negative Central Shear DIII-D Discharges with L-mode Edge*

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An MHD instability, which is kink-like in the sense that the displacement phase is in the same direction at all the affected flux surfaces, has been observed in several negative central shear discharges with L-mode edge in the DIII-D Tokamak. These instabilities alter discharge evolution and the desired confinement parameters and plasma β are not obtained during the H-mode phase of these discharges. In order to obtain the required plasma conditions prior to start of the H-mode, the instability has to be identified and avoided. The instability occurs when the minimum safety factor q is ~2.0 and the safety factor profile is reversed in the center. Detailed analyses of the Mirnov probe, motional Stark effect (MSE) and electron cyclotron emission (ECE) data show that the instability is initially localized near the q~2 flux surface at the onset and has an n=1 mode number and then grows and expands into a broad mode. Later, this kink-like mode is followed by a tearing mode with a magnetic island structure. With the stability analysis indicating robust ideal stability and marginal stability of resistive interchange mode, and noting the early localized nature of the instability, we conclude that this is a resistive interchange mode [1]. The rise time of the global mode and saturation amplitude are analyzed, and correlation with discharge profiles and history is studied. The criterion for tearing modes is analyzed as the discharge evolves and correlated with the onset of a tearing mode, which follows the resistive interchange mode. The paper will present experimental observations on the instabilities at the onset and during evolution, and the results of the stability analyses for various time slices. The correlation between the characteristics of the resistive modes and plasma profiles will be examined.

[1] M.S. Chu, et al., Phys. Rev. Lett. **77**, 2710 (1996).

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