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EX/P6-15: Coexistence of Alfvénic Modes Induced by Energetic Electrons with ECRH on HL-2A

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The MHD instabilities driven by energetic-particle are of particular importance for future burning plasma devices, where energetic particles will be produced by high power heating and fusion reaction. The energetic electron behaviors in present devices can provide a contribution for burning plasma research, because their effect on low-frequency MHD modes in the former has the analogous effect of the fast ions in the latter. In this paper, the new experimental results about coexistence of the low frequency multi-modes driven by energetic electrons with high ECRH power are presented.
The evolution of the magnetic fluctuations during ECRH has been observed by means of Mirnov coils and soft x-ray arrays. Experimental results show that the multi-mode coexistence phenomena occur during the high power ECRH both with on-axis and off-axis deposition. With the low ECRH, only one mode can be observed, which has been identified as e-BAE. When the power is over about 600kW, two or three peaks appear in the spectra of the magnetic fluctuation. The modes located outside of 20cm of the minor radius. These modes are proved to be related with the energetic electrons strongly and disappear when the plasma density increase during gas puffing.
To obtain the detail features of the modes, the mode numbers, the power density spectra and the correlation spectra both toroidally and poloidally have been analyzed. The toroidal mode numbers of the modes are n = 1 or 2. The frequencies of the modes are proportional to Alfv´en frequency, but much lower than it. The statistical curves for frequency of the three modes versus the B ne -1/2 have been obtained with the magnetic field from 1.2T to 1.4T and the density from 0.3×1013cm-3 to 1.4×1013cm-3, indicating that all of them are related with low frequency Alfv´en modes. The frequency spectra are broadening and overlap each other, when the ECRH power high enough. . No clear nonlinear interaction between the modes and the other low frequency MHD mode occurs in high power ECRH plasma from the bicoherence spectra analysis.
The multi-mode coexistence phenomena driven by energetic electrons with high ECRH power are observed for the first time. This evolution should be very important for the ITER, because the multi-modes coexistent magnetic structure in the high temperature plasma will affect the plasma transport greatly.

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