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Excitation of frequency jump by barely Passing Electrons

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An e-fishbone frequency jump has been observed on Tore Supra , which is important for the redistribution of energetic electrons and energetic particle losses. E-fishbone periodic frequency jump phenomena are also observed on HL-2A . Soft X-ray tomography shows that the poloidal and toroidal mode numbers are 1/1 and 2/2 with the frequency jump. In this paper we present a theoretical base of the frequency jump in the e-fishbone experiments. It is identified that barely passing electrons are the drive of the e-fishbone, rather than the trapped electrons. The frequency jumps in HL-2A E-fishbone experiments are numerically reproduced. E-fishbone frequency increases with the hot electron energy which is consistent with the experiments. The growth rate of the mode (m=2, n=2) is greater than the one of the mode (m=1, n=1) in contrast to the pure MHD prediction. The calculated temporal evolutions of the hot electron energy and the kink mode amplitude are periodic which in good agreement with the observed e-fishbone jump cycle. The theory provides an insight on HL-2A and Tore Supra experiments.

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