Kinetic effects of trapped energetic particles on stability of external kink modes with a resistive wall

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Kinetic effects of trapped energetic particles (EPs) on stability of the external kink mode with a resistive wall are investigated in detail, on the basis of the theory model developed in a previous paper [G. Z. Hao, A. K. Wang, Y. Q. Liu, and X. M. Qiu, Phys. Rev. Lett. **107**, 015001 (2011)]. The results indicate that, when the perpendicular beta β^* of the trapped EPs exceeds a critical value β_c^*, a bursting fishbone-like mode (FLM) instability, with external kink eigenstructure ,can be triggered, which rapidly grows with increasing $\beta^*(>\beta_c^*)$, and eventually becomes a dominant instability. Detailed physical analyses are carried out, comparing radial profiles of the EPs kinetic energy for both the FLM and the conventional resistive wall mode (RWM). On the other hand, a mode conversion between the FLM and RWM can directly occur. This work also presents a systematic investigation of effects of various physical parameters on the FLM instability. An interesting new finding is the existence of multiple critical points in β^*, for the FLM triggering. The number of critical points depends sensitively on the trapped EPs pitch angle. In addition, it is found that there can be a critical value of the pitch angle, beyond which the critical β_c^*, for triggering the FLM, jumps from a large value to a small one. The FLM instability, with the $m/n = 3/1$ mode structure, can also be triggered by the trapped EPs. © *2012 American Institute of Physics*. [http://dx.doi.org/10.1063/1.3692185]