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The effects of resonant magnetic perturbations on the orbit losses of energetic ions

Haotian Huang[1], Lu Wang[2]

International Joint Research Laboratory of Magnetic Confinement Fusion and Plasma Physics,

Huazhong University of Science and Technology, Wuhan 430074, China

e-mail (speaker):13125104242@163.com

Abstract: In current tokamaks, external resonant magnetic perturbations (RMPs) are usually used to mitigate the edge localized mode (ELM). However, many related experimental and simulation results show that RMPs can increase the orbit losses of energetic ions, which is harmful for the safe operation of tokamak.[1]-[3] Based on this situation, an analytic investigation on the effects of RMPs on the orbit losses of energetic ions will be shown in this work.

Due to existence of perturbed magnetic field $\delta\vec{B}$, the bounce averaged radial drift velocity relative to the distorted flux surface for deeply trapped energetic ions can be written as $< \vec{v}_d \cdot \nabla V >_b = \frac{c\mu B_0}{e\chi'} \frac{1}{4K(k)} \sum_n \oint d\theta \frac{A_n(\theta)(-n\sin n\zeta_0)+B_n(n\cos n\zeta_0)}{\sqrt{k^2-\sin^2(\frac{\theta}{2})}}$.[4] We will calculate the ratio of loss time to the slowdown time of the energetic ions, and analyze its dependence on various parameters, such as the mode numbers of perturbed magnetic fields, plasma current, plasma density, temperature, energy and pitch angle of energetic ions.

Key words: resonant magnetic perturbations, energetic ions, orbit losses.

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