Toroidal modeling of plasma response to RMP fields for HL-2M

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In this work, the characteristics of the n=1, 2, 4 resonant magnetic perturbation (RMP) fields are studied for the reference high-beta_N (still smaller than the no-wall beta limit) equilibrium for the new device HL-2M, by employing the MARS-F code (Y.Q. Liu *et al* 2000 *Phys. Plasma* **7** 3681). The best and worst coil phasing for different coil current configurations, in terms of edge localized mode (ELM) control, are predicted. The role (i.e. screening or amplifying) of plasma response on the external RMP field depends on the coil phasing, ion toroidal rotation, toroidal mode number n. When the corresponding best phasing for the different n is chosen, the plasma response has the significant amplification effect for the resonant and some non-resonant poloidal Fourier harmonics of external RMP fields. When the worst phasing is assumed, the RMP filed is generally amplified (screened) by the plasma response in the inner (outer) side of the rational surfaces (as shown in Fig.1). In addition, the strength of total RMP field in the best phasing is large enough to produce loss of the confined passing fast ions, when the 10 kAt coil current is assumed. Compared with the vacuum RMP field, the plasma response enhances the transport and loss of the chosen passing fast ions in the best phasing. While, in the worst phasing, the plasma response makes the fast ion confinement better (as shown in Fig.2), compared with the vacuum RMP case for all n. More interestingly, both the maximum of poloidal Fourier harmonic of radial RMP field along the minor radius and the strength of pitch-resonant radial field at the corresponding rational surface affect the drift orbit of fast ions, resulting in the change of fast ion transport and loss. The results highlight that during the design of 'optimal' phasing of RMP coil current configuration for ELM control, the effect of coil phasing on fast ion transport and loss requires to be taken into account.

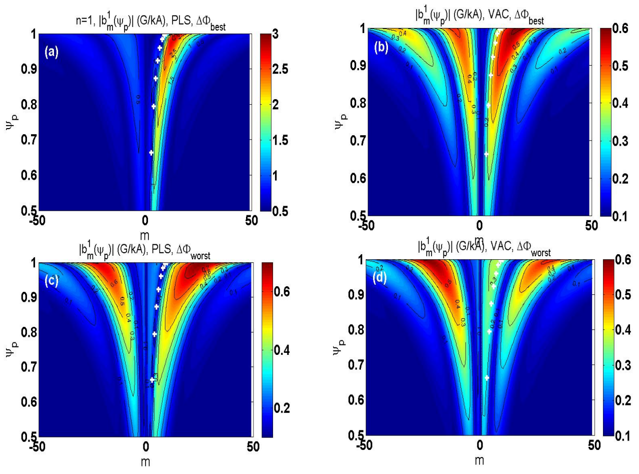

Figure 1:Poloidal spectrum of the total RMP field (plasma response + external RMP field) for the n=1 configuration with the best (a) and worst (c) coil phasing. (b) and (d) plot the vacuum RMP fields corresponding to (a) and (c), respectively. The symbols '+' denote the locations of rational surfaces. The resonant poloidal Fourier harmonics are m=2,...,10.

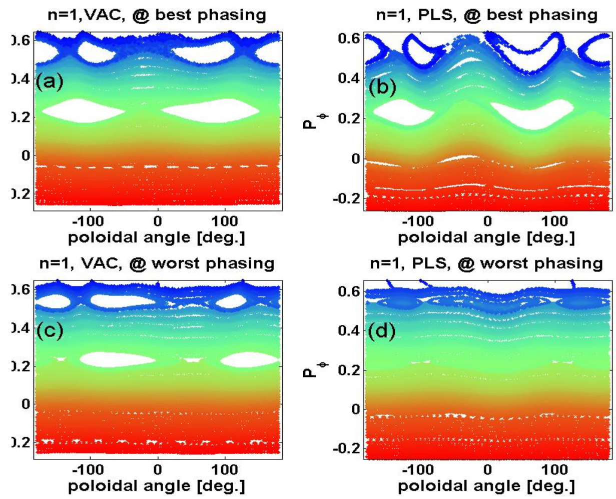

Figure 2: Comparison of Poincare plots of particle drift orbits for the n=1 vacuum (a,c) and total (vacuum RMP field+plasma response) (b,d) RMP fields. (a) and (b) show the case when the best RMP coil phasing is assumed. (c) and (d) present the case with the worst phasing Here, the 10 kAt for coil current is assumed..