

RF eigenmode analysis of KSTAR vacuum vessel for ICRH pre-ionization

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In the early stage of KSTAR operation, startup discharge will be initiated by a blip resistance. The expected loop voltage is less than 5 volt because of lack of power supplier and blip resistance capacity. For successful startup overcoming such a low loop voltage, two different types of pre-ionization method are suggested. The one is the 2nd harmonic ECH heating with frequency of 84 GHz and power of 500 kW. According to the previous works, especially DIII-D[1] which has similar vessel volume with KSTAR, the threshold power was about 800 kW. The result implies that ECH power for KSTAR start up is also marginal or somewhat insufficient. Another method as a backup of ECH is RF preionization. Vacuum RF breakdown by exciting a vacuum eigenmode that is a kind of cavity resonance in the vessel can be another candidate of preionization. Because of extremely low Q characteristic of a vacuum cavity resonance, a strong electric field sufficiently break down the vacuum can be expected. In this works, we investigate conditions of eigenmode formation in KSTAR vessel. For simplicity of the analysis and for proper boundary conditions of D-shaped KSTAR vessel, we used the FDM method adopting an analytic magnetic flux coordinate. RF frequencies, corresponding cavity modes, and the effects of geometrical parameters on cavity resonance frequency will be discussed.

[1]. G. L. Jackson *et al.*, Bull. Am. Phys. Soc. **48**, 207 (2006).