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Modeling the Gap Eigenmode of Shear Alfvén Waves on the LAPD

Lei Chang[1], Matthew Hole[2], Boris Breizman[3], and Ning Hu[1]
[1]College of Aerospace Engineering, Chongqing University, Chongqing, China
[2]Centre for Plasmas and Fluids, Australian National University, Canberra, Australia
[3]Institute for Fusion Studies, University of Texas at Austin, Austin, USA

The gap eigenmodes of shear Alfvén waves are not subject to continuum damping and even readily destabilized by energetic particles, which are then expelled by these global eigenmodes from magnetic confinement, threatening the success of sustaining fusion reaction. Therefore, it is of great importance to characterize the formation of the gap eigenmode of shear Alfvén waves. Low temperature plasma can be a promising candidate for this study, considering its simpler geometry, easier diagnostic access and lower cost, compared with those of traditional fusion reactors. Through configuring an array of periodic magnetic mirrors along the LArge Plasma Device (LAPD), a linear plasma cylinder with low temperature, the spectral gaps of shear Alfvén waves were observed but their gap eigenmodes have not yet been formed inside these gaps.[1] To guide the experimental implementation of these Alfvénic gap eigenmodes on the LAPD, theoretical and numerical efforts were made first on whistlers and later on shear Alfvén waves.[2, 3] For the latter, however, it assumed a step-like density profile in radius and nearly infinite machine length, which are not the case on the LAPD. Recent effort was given to the influence of number and depth of magnetic mirror on the formation of Alfvénic gap eigenmode, indicating that the limited length of the LAPD can be compensated by increasing the depth of magnetic mirror.[4] The present work details the modeling results of Alfvénic gap eigenmode on the LAPD using exact experimental parameters. Three dimensional wave field is first given, showing that the previously observed spectral gap is not global but local, a lucky coincidence. Then the effects of density profile in radius and the depth of magnetic mirror on the formation of Alfvénic gap eigenmode are described in detail, based on continuum damping theory and Bragg's law.

References

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