Fast changes in the mode structure of chirping energetic particle driven modes

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Super-thermal energetic particles (EP) in tokamak plasmas can excite various instabilities which can lead to an enhanced transport of fast particles. These instabilities constitute a nonlinear system where kinetic and MHD non-linearities can both be important making it difficult to describe the phenomenon [1]. Our aim is to experimentally investigate the rapid changes in the radial structure of energetic particle driven modes during the non-linear chirping phase. This analysis has two objectives. One, for specific modes the results could confirm the assumption of codes modelling the wave-particle interaction by retaining the radial structure of the mode. Two, the results can serve as the basis of comparison with non-linear codes which can take the changes of the radial eigenfunction into account.

In this contribution we present our results on the investigation of beta induced Alfvén eigenmodes (BAEs) and EP-driven geodesic acoustic modes (EGAMs) observed in the ramp-up phase of off-axis NBI heated plasmas in ASDEX Upgrade [2]. We also present the analysis of the dedicated EGAM shots performed in 2014. These modes were well visible on several soft X-ray line-of-sights which made it possible to analyse their spatial structure. The rapidly changing mode frequency and the low signal-to-noise ratio are handled with an advanced time-frequency transform based method [3].

Our investigation shows that in case of the observed BAEs the changes in the radial eigenfunction are smaller than the uncertainty of our measurement. In case of EGAMs the results consistently show a slight shrinkage of the mode structure which could be in line with the redistribution of the fast ion population.

References

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