Internal amplitude and structure of high frequency compressional and global Alfvén eigenmode density perturbations in NSTX

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Fast-ions (e.g. fusion alphas and neutral beam ions) will potentially excite high frequency compressional (CAE) and global (GAE) Alfvén eigenmodes in ITER or a Fusion Nuclear Science Facility device [1]. High frequency AEs have been shown to cause fast-ion transport [2,3,4], correlate with electron thermal transport [5], and are postulated to cause energy transport [6,7,8] and contribute to ion heating [9]. New analysis of previously reported 10,11] reflectometry measurements is presented yielding the density perturbation (δn) amplitude and structure of the CAEs and GAEs in a high power (6 MW), beam-heated H-mode plasma (shot 141398) very similar to those discussed in Ref. [5]. The measurements are inverted, constructing δn vs. R for each mode from basis functions in order to best fit the measurements using a synthetic diagnostic code to model the reflectometer response. The analysis shows CAEs tend to have δn with larger amplitude in the plasma core than in the edge, while the opposite tends to be true for the GAEs. The resulting δn are used in modeling the effects of the modes on energy transport and ion heating. Also, as part of an ongoing effort to validate the physics model of the hybrid kinetic and MHD code, HYM [12], the δn are compared to previously reported simulation results from HYM [8]. In particular, the structures of GAEs from simulation are compared with those from experiment having matching mode numbers and approximately matching frequencies. The comparison reveals significant similarities and differences. The agreement between simulation and experiment shows promise for the development of HYM as a tool for predicting CAE and GAE activity, while the differences offer clues that will help prioritize future development of the physics model of HYM.

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