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Negative triangularity shaping effects on Alfvén eigenmodes in DIII-D plasma

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Linear numerical simulations using FAR3d indicate that negative triangularity (NT) shaping of plasma in DIII-D lowers the growth rate of energetic particle (EP) driven Alfvén eigenmodes (AEs) as compared to the positive triangularity (PT) shaping of plasma [1]. Recently, there is a renewed interest in the NT shaping for its benefits of reduced microturbulence, better thermal confinement and high normalized beta achievable in fusion plasmas [2,3]. An investigation based on the effects of NT plasma shape on the EP driven AE activity in DIII-D is performed using the gyrofluid code - FAR3d. Numerical simulations performed at a discrete time determine AEs at similar frequencies as observed in the experiments. However, the lower growth rates in NT plasma are not due the negative triangularity shape but are caused by different fast ion density profile and lower q-values in the NT discharge as compared to the PT discharge. We also compared FAR3d results with linear gyrokinetic simulations using the GTC code to include more damping physics and observed similar trends of lower AE growth rates with NT plasma shaping. However, DIII-D experiments did not report any significant advantage of NT shaping for suppressing AEs induced fast ion transport [4]. The study of nonlinear state of the EP driven AEs and the associated fast ion transport can be readily performed using the nonlinear version of FAR3d. The linear simulations shall be extended to the nonlinear regime for long simulation times to compare the saturation mechanism and fast ion transport in the NT and PT regimes. Our findings should lead to new physical insights regarding the benefits of NT shaping of the plasmas in fusion devices.

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