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# ITR/P1-34: Benchmark of Gyrokinetic, Kinetic MHD and Gyrofluid Codes for the Linear Calculation of Fast Particle Driven TAE Dynamics

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Fast particles in ITER may originate from the fusion process itself or from external heating, as Neutral Beam Injection (NBI). It is well known that those non-thermal populations of fast particles may interact with otherwise stable Alfven waves in the bulk plasma driving them unstable. This process takes place as a resonance phenomenon that requires a kinetic treatment of the fast particles but not necessarily a kinetic treatment of the bulk plasma. The rising amplitude of the oscillating electro-magnetic field in the plasma may lead to a redistribution or a loss of supra-thermal particles. In consequence, a degradation of the heating efficiency or even hazards for in-vessel components of the machine are possible.
In the last decades, much effort has been invested in the development of theory and codes that can be used to describe and explain the related phenomena. However, up to now, there is no well-understood standard case that these models have been tested against quantitatively. Providing the first quantitative code comparison, the ITPA Energetic particle Topical Group is contributing to the design activity on the ITER operation scenario. The benchmark of the codes for the energetic ion driven modes is necessary for the accurate prediction of plasma behavior in ITER. The international benchmarking effort between a variety of codes shall ensure scientific quality and reliability when predictions for ITER will be made.
Comparisons will be made between the different codes at different levels of approximation for growth rates, frequencies and eigenfunctions. While the limit of zero orbit width has been well met by all codes, the spread of the results in the zero Larmor radius case illustrates the necessity of a quantitative comparison. Furthermore, the importance of finite Larmor radius (FLR) effects is shown which lower the growth rates considerably. The benchmark will provide codes capable of predicting Alfven eigenmode physics in ITER reliably.

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