Turbulent transport of MeV range cyclotron heated minorities as compared to fusion alphas

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The success of magnetic confinement fusion strongly depends on the radial transport of alpha particles from the birth energy down to the thermalized ash. At some suprathermal energy range turbulence can play a major role in radially transporting alpha particles [1]. Highly energetic minorities, which can be produced in the three ion minority (TIM) ion cyclotron resonance heating scheme [2], have been proposed to be used to experimentally study the confinement properties of fast ions without the generation of fusion alphas.

We present a gyrokinetic study of the turbulent transport of TIM heated minorities (specifically, ³He in a H–⁴He plasma) characterized by a non-Maxwellian energy distribution with an MeV-range effective temperature, and make a comparison to the transport of fusion born alpha particles. Our results indicate that care must be taken when conclusions are drawn from experimental results: Although the effect of turbulence on these particles is similar, differences in their distribution functions – ultimately their generation processes – make the resulting turbulent fluxes different. Alphas tend to transport outwards in steady state, while turbulence acts to accumulate the heated minorities in the region where the power absorption is the largest.