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Predictions of the Transport-limited Fusion Alpha Profile in ITER[1]

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We present a simple 1D transport model prediction for the alpha density profile in an ITER burning plasma. Thermal species profiles, which provide the basis for the alpha birth and collisional slowing-down rates, come from a recent ITER H-mode prediction using the EPED model for the pedestal and a quasilinear microturbulent model in the core [1]. The model includes the fusion source, an effective sink into a population of helium ash, and diffusive transport due to both microturbulence and alpha-driven Alfvén eigenmodes (AEs). Where applicable, we assume the local distribution maintains the classical slowing-down form. The microturbulent (passive) contribution to alpha transport is given by combining the known absolute energy flux appropriate for a $Q = 10$ scenario with the GYRO simulation-fitted model for the quasilinear transport ratio given in Ref. [2]. A "stiff" transport model gives the alpha-driven AE component. In this model, *local* AEs drive the alpha gradient to the *local* mode stability threshold determined by fully realistic GYRO simulations. Both the stiffness [3] and locality [4] of AE transport are supported by previous work. We compare the impact on the AE stability threshold of using Maxwellian versus slowing-down forms for the alpha distribution. In general, the AEs are found to re-distribute fusion alphas within the plasma core, but the Alfvén avalanche does not appear to propagate to the loss boundary. Microturbulence can drive modest alpha losses at the edge.

[1] J.E. Kinsey et al., Nucl. Fusion **51**, 083001 (2011)
[2] C. Angioni et al., Nucl. Fusion **49**, 055013 (2009)
[3] E.M. Bass and R.E. Waltz, Phys. Plasmas **17**, 112319 (2010)
[4] E.M. Bass and R.E. Waltz, Phys. Plasmas **20**, 012508 (2013)

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