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Effect of superbanana diffusion on the fusion reactivity in QHS stellarators[1] FRED HINTON, UCSD — The effect of superbanana diffusion on the D-T fusion reactivity in QHS (quasi-helically-symmetric) stellarators has been investigated. The fusion reactivity was expected to be significantly reduced because of the strong energy-dependence of the diffusion coefficient in the "1/nu regime." However, several mitigating effects make this effect weaker: (1) with realistic density and temperature profiles, the reaction rate peaks in the plasma core, while the diffusion is largest near the edge, where the helical magnetic field ripple is strongest; (2) the poloidal precession rate may be larger when the ambipolar electric field is included, which would reduce the superbanana orbit width and bring the transition to the "nu regime" down to lower energies. The Fokker-Planck equation has been solved numerically, including superbanana diffusion as well as energy scattering, to obtain the energy dependence for the tail of the ion distribution function. A previous calculation used separation of variables, assuming uniform ion temperature and electrostatic potential, to obtain a steady-state solution. It was found that, even for very small values of the effective helical field ripple, the fusion reactivity was significantly reduced. The calculation reported on here uses an initial-value formulation to obtain a steady state solution without assuming the ion temperature or electrostatic potential to be uniform. A smaller reduction of the fusion reactivity due to superbanana diffusion has been found.

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