Free boundary three-dimensional anisotropic pressure equilibria

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An anisotropic pressure model for three-dimensional magnetohydrodynamic equilibria with nested magnetic flux surfaces has been implemented in a free boundary version of the VMEC code.[1] The energetic particles are described with a modified Bi-Maxwellian distribution function[2] that satisfies the constraint $\mathbf{B} \cdot \nabla \mathcal{F}_h = 0$. This model has already been successfully applied under fixed boundary conditions.[3] Applications to 2-field period quasiaxisymmetric stellarator reactor system at large $\langle\beta\rangle \sim 5\%$ with large pressure anisotropy and off-axis hot particle deposition have been explored to test the limits of the code. The hot particle pressure distributions reproduce the structures obtained under fixed boundary conditions. For example, for $p_\perp > p_{||}$ and high field side hot particle deposition, the $p^h_\perp$ distribution localises also on the high field side contrary to the $p^h_{||}$ structure which concentrates on the low field side. For low field side deposition, both hot particle components appear on the low field side. A radially outward shift of the entire plasma column constitutes the dominant finite $\langle\beta\rangle$ effect while the alterations of the shape of the plasma-vacuum interface, though clearly observable, are less important.

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