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Theory and computation of general force balance in non-axisymmetric tokamak equilibria JONG-KYU PARK, NIKOLAS LOGAN, ZHIRUI WANG, KIMIN KIM, PPPL, ALLEN BOOZER, CU, YUEQIANG LIU, CCFE, JONATHAN MENARD, PPPL — Non-axisymmetric equilibria in tokamaks can be effectively described by linearized force balance. In addition to the conventional isotropic pressure force, there are three important components that can strongly contribute to the force balance; rotational, anisotropic tensor pressure, and externally given forces, i. e. $\vec{\nabla} p + \rho \vec{v} \cdot \vec{\nabla} \vec{v} + \vec{\nabla} \cdot \overleftrightarrow{\Pi} + \vec{f} = \vec{j} \times \vec{B}$, especially in, but not limited to, high β and rotating plasmas. Within the assumption of nested flux surfaces, Maxwell equations and energy minimization lead to the modified-generalized Newcomb equation for radial displacements with simple algebraic relations for perpendicular and parallel displacements, including an inhomogeneous term if any of the forces are not explicitly dependent on displacements. The general perturbed equilibrium code (GPEC) solves this force balance consistent with energy and torque given by external perturbations. Local and global behaviors of solutions will be discussed when $\vec{\nabla} \cdot \overleftrightarrow{\Pi}$ is solved by the semi-analytic code PENT and will be compared with MARS-K. Any first-principle transport code calculating $\vec{\nabla} \cdot \overleftrightarrow{\Pi}$ or $\vec{f}$, e. g. POCA, can also be incorporated without demanding iterations. This work was supported by DOE Contract DE-AC02-09CH11466.

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