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Current Hole Sustainment in Tokamaks[1] P.B. PARKS, M.S. CHU, General Atomics, T. OIKAWA, JAERI — Recent experiments in various tokamaks JET, JT-60U [1] and DIII-D, observed a central region with virtually zero current, a so-called current hole. A steady-state current hole may eliminate the need for a loop voltage and non-inductive current drive, while improving confinement by enlarging the perimeter of the negative shear region. A theoretical model of a current hole equilibrium is presented. Sustainment requires a sufficiently large particle source inside the hole; the resulting outward particle flow across the flux surfaces prevents poloidal flux collapse at the magnetic axis. Steep current profiles near the edge may trigger high-m tearing modes, so Ohms law includes a current diffusivity term that dominates in a thin boundary layer near the edge of the hole. Regular solutions for the current density are found at the edge, and thus steady state appears to be possible. For the exterior region, the model leads to a Grad-Shafranov equation with two prescribed flux-surface functions: the total particle source rate within a flux surface, and the parallel bootstrap current distribution. The calculated hole size is in good agreement with the measured hole size in the JT-60U experiment.
[1] T. Fujita, et al., Phys. Rev. Lett. **87**, 245001 (2001).

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