# Tokamak equilibria with central current holes and negative current drive

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## Abstract

Several tokamak experiments have reported the development of a central region with vanishing currents (the current hole). Straightforward application of results from the work of Greene, Johnson and Weimer [Phys. Fluids, **3**, 67 (1971)] on tokamak equilibrium to these plasmas leads to apparent singularities in several physical quantities including the Shafranov shift and casts doubts on the existence of this type of equilibria. In this paper, the above quoted equilibrium theory is re-examined and extended to include equilibria with a current hole. It is shown that singularities can be circumvented and that equilibria with a central current hole do satisfy the magnetohydordynamic equilbrium condition with regular behavior for all the physical quantities and do not lead to infinitely large Shafranov shifts. Isolated equilibria with negative current in the central region could exist. But equilibria with negative currents in general do not have neighboring equilibria and thus cannot have experimental realization, i.e. no negative currents can be driven in the central region.