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Investigation of plasma performance and formation of transport barriers based on bifurcation concept

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This research study plasma performance in fusion Tokamak system by investigating parameters such as central plasma pressure and particle density in the presence of an ETB (edge transport barrier) and an ITB (internal transport barrier). The plasma is modeled based on bifurcation concept using a suppression function that can result in formation of transport barriers. In this model, thermal and particle transport equations, including both neoclassical and anomalous effects, are solved simultaneously in slab geometry. The neoclassical coefficients are assumed to be constant while the anomalous coefficients depend on gradient of local pressure and density. The suppression function, depending on flow shear and magnetic shear, is assumed to affect only on the anomalous channel. The flow shear can be calculated from the force balance equation, while the magnetic shear is calculated from the given plasma current. It is found that as the position of driven current peak is moved outward from the plasma center, the central pressure is increased. But at some point it starts to decline, mostly when the driven current peak has reached outer half of the plasma. The higher pressure value results from the combination of ETB and ITB formations. The drop in central pressure occurs because ITB starts to disappear.

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