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Investigation of an edge transport barrier formation in fusion tokamak using the BOUT++ framework

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The heat and particle transport equations are used to study the formation of an edge transport barrier (ETB) in a tokamak plasma based on the two-field bifurcation concept. These equations are simultaneously solved by a numerical method using the BOUT++ physics framework resulting in plasma pressure and density profiles as a function of time and plasma radius. The transport effects include both neoclassical and anomalous effects, where the latter can be suppressed by the flow shear mechanism. The flow shear is proportional to the multiplication of the pressure and density gradients. The main heat and particle sources are localized at the center and edge of the plasma, respectively. The result shows that when the heat or particle source surpasses its threshold value, there will be the formation of the ETB at the plasma edge. As a result, pressure and density at the center are enhanced. Moreover, the effect of varying neoclassical and anomalous transport coefficients on the pressure and density profiles is also investigated. It is found that as the transport values are increased, the plasma performance drops, and at some point, the plasma can no longer form an ETB. The results are compared with those solved by MATLAB from previous research work for benchmarking purposes. This research is supported by TSRI Fundamental Fund project number 91526.

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