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Investigation of L-H-L Transitions Criteria and Hysteresis Based on Bifurcation Concept

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Investigation of L-H-L Transitions Criteria and
Hysteresis Based on Bifurcation Concept

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This research aims to study the criteria for the forward L-H transition and backward H-L back transition as well as hysteresis depth in tokamak fusion plasmas based on bifurcation concept. Three transport equations including thermal, particle and toroidal momentum density are solved simultaneously, resulting in the prediction of plasma pressure, plasma density and toroidal velocity profiles at steady state. The transport effects include both neoclassical and anomalous transport with velocity shear dependent suppression function. The results show that the flux (thermal/particle/momentum) versus gradient (pressure/density/velocity) space exhibits s-curve bifurcation nature in which a forward L-H transition requires higher flux than that of the backward H-L transition, hence hysteresis behaviors. In addition, it is found that ratio of the plasma flux at the forward L-H transition over the backward H-L transition depends sensitively on thermal, particle and toroidal momentum neoclassical and anomalous transports.

Keyword: bifurcation, hysteresis, transport barrier

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