Linear Analysis of Cross-field Dynamics with Feedback Instability on Detached Divertor Plasmas

Hiroki HASEGAWA[1, 2], Hirohiko TANAKA[3] and Seiji ISHIGURO[1, 2]

[1]*National Institute for Fusion Science (NIFS), National Institutes of Natural Sciences (NINS), Toki, Japan*
[2]*Department of Fusion Science, The Graduate University for Advanced Studies, SOKENDAI, Toki, Japan*
[3]*Graduate School of Engineering, Nagoya University, Nagoya, Japan*

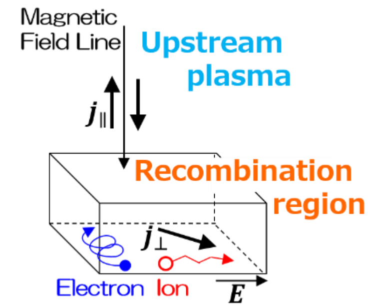


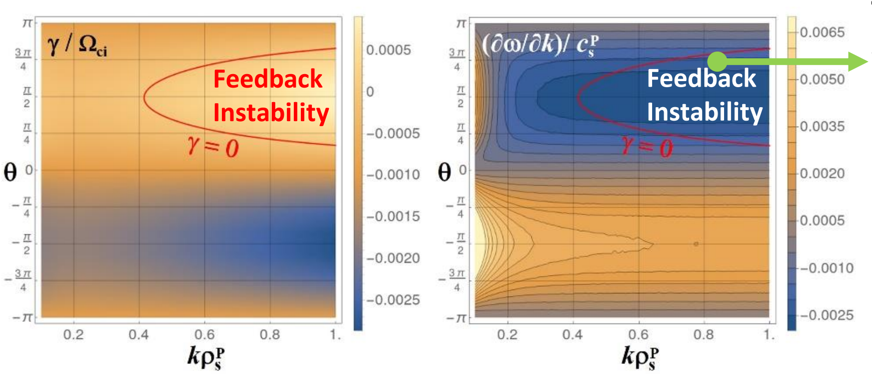
Fig. 1: Schematic diagram of the detached divertor plasma from the viewpoint of the coupling model.

The theoretical model of the feedback instability in the coupling system between the magnetized plasmas characterized by different current mechanisms (see **Fig. 1**) is proposed to explain the correlation between the detachment and the cross-field transport:

(1) The unstable mode has been found from the dispersion relation under a certain condition for both the typical fusion torus case (see **Fig. 2**) and the NAGDIS-II linear device case.

(2) The feedback instability can provide the cross-field plasma transport in the boundary layer of magnetic fusion torus devices (see **Fig. 3**).

(3) The transport property estimated by the proposed model is in good agreement with that of the spiralling plasma ejection observed in the NAGDIS-II experiment (see **Fig. 4**).



The plasma can be transported with the speed ~ 0.002 c_s^P.

Figs. 2 (left) & 3 (right): Dependences of the growth rate γ and the group velocity $\partial\omega/\partial k$ of the unstable mode on the wave number k and the propagation direction θ for the typical fusion torus case. Here, c_s^P is the ion acoustic speed in the upstream plasma.

Fig. 4: Comparison between the spiralling plasma ejection observed in the NAGDIS-II experiment and the feedback instability model.