Numerical Investigation of the Energetic Particle Redistribution and Interaction with Alfvén Eigenmode in Heliotron J

P. Adulsiriswad[1], Y. Todo[2], S. Yamamoto[3], S. Kado[4], S. Kobayashi[4], S. Ohshima[4], T. Minami[4], H. Okada[4], A. Ishizawa[1], Y. Nakamura[1], S. Konoshima[4], T. Mizuuchi[4], K. Nagasaki[4]

[1] Graduate School of Energy Science, Kyoto University
[2] National Institute for Fusion Science
[3] National Institutes for Quantum and Radiological Science and Technology
[4] Institute of Advanced Energy, Kyoto University

- The global Alfvén eigenmode (**GAE**) destabilized by energetic particles (EPs) in Heliotron J was investigated with a hybrid simulation code MEGA[1]. The EPs transport, the resonance interactions, and their dependencies on the equilibrium distribution function were clarified.
  - **(1) Bump-on-tail**, (Experimental plasma)
  - **(2) Slowing-down**, (Ideal case, Low charge exchange loss)

[1] Adulsiriswad et al., NF **60**, 096005 (2020)

➢ Resonance Condition in EP Velocity Space:

- The **high velocity EPs** in the core region that have sufficiently large orbit width can interact with the **n/m=2/4 GAE** (Fig.1a) through toroidicity-induced resonance (Fig.1b).
- The **low velocity EPs** have lower orbit width (Fig.2a). They can interact with **n/m=2/4 GAE** through toroidicity, helicity and bumpy-induced resonances (See Fig.2b).

➢ EP Transport by the n/m=2/4 GAE:

- Fig. 1a shows Poincaré plots of the high velocity resonant EP orbit demonstrating the radial transport by the **n/m=2/4 GAE** in the nonlinear phase.
  → If the **high velocity** EPs have a high distribution function, the core EP transport can result in a hollow EP spatial profile.

Fig. 1a High Velocity EP's Poincare Plot

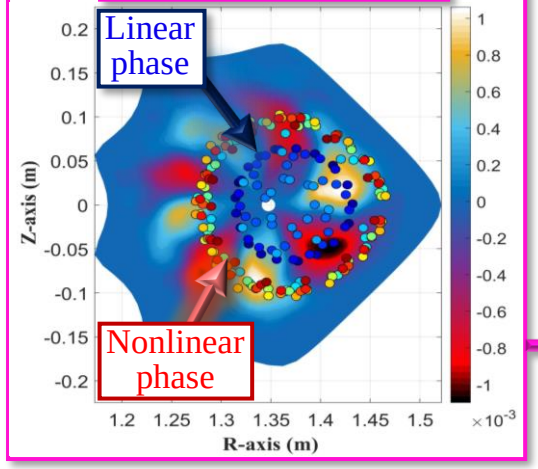

Fig. 1b $\delta f_h(v,\Lambda)$ for Bump-on-Tail

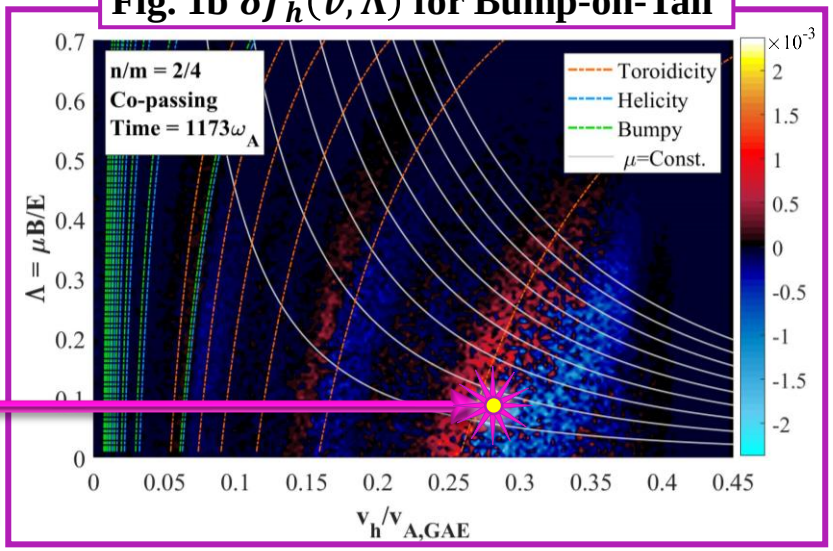

Fig. 2a Low Velocity EP's Poincare Plot

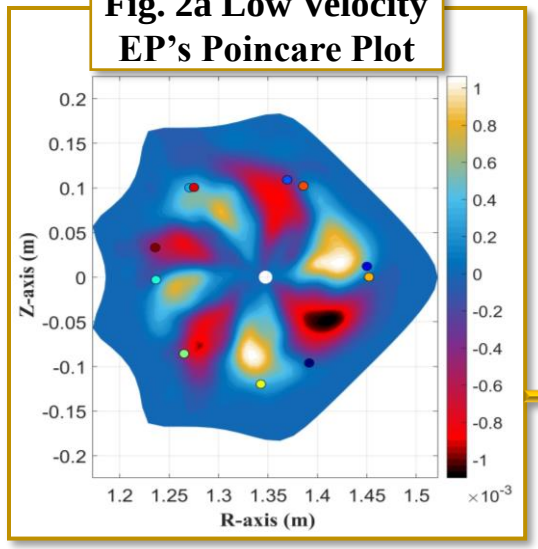

Fig. 2b $\delta f_h(v,\Lambda)$ for Slowing-down