Study of the Interaction between Peripheral Energetic Particle Mode and Energetic Particles in Heliotron J with MEGA, a Hybrid MHD Simulation with Free Boundary Condition

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❖The energetic particle (**EP**) **driven MHD** mode in Heliotron J, a **low shear** helical-axis heliotron, was simulated by MEGA, a hybrid simulation code.
- Previously, the dominant **n/m=1/2 EPM** at the plasma edge cannot be reproduced[1].
- This discrepancy is tackled by the **free boundary** sim.

❖ Edge-localized Gradient ($\nabla f_{h0,edge}$)

➢ The **EP drive** for the peripheral low-n mode is **underestimated** by the **fixed** boundary assumption.
- In the **free** boundary case, the mode profile is shifted outward.
  - The perceived EP pressure gradient ($\boldsymbol{\nabla P_{h0}}$) becomes **steeper** (enhance EP drive)[2].
  - Linear growth rate ($\boldsymbol{\gamma/\omega_A}$) is higher than the fixed boundary case, despite having lower EP beta ($\boldsymbol{\beta_{h0}}$).

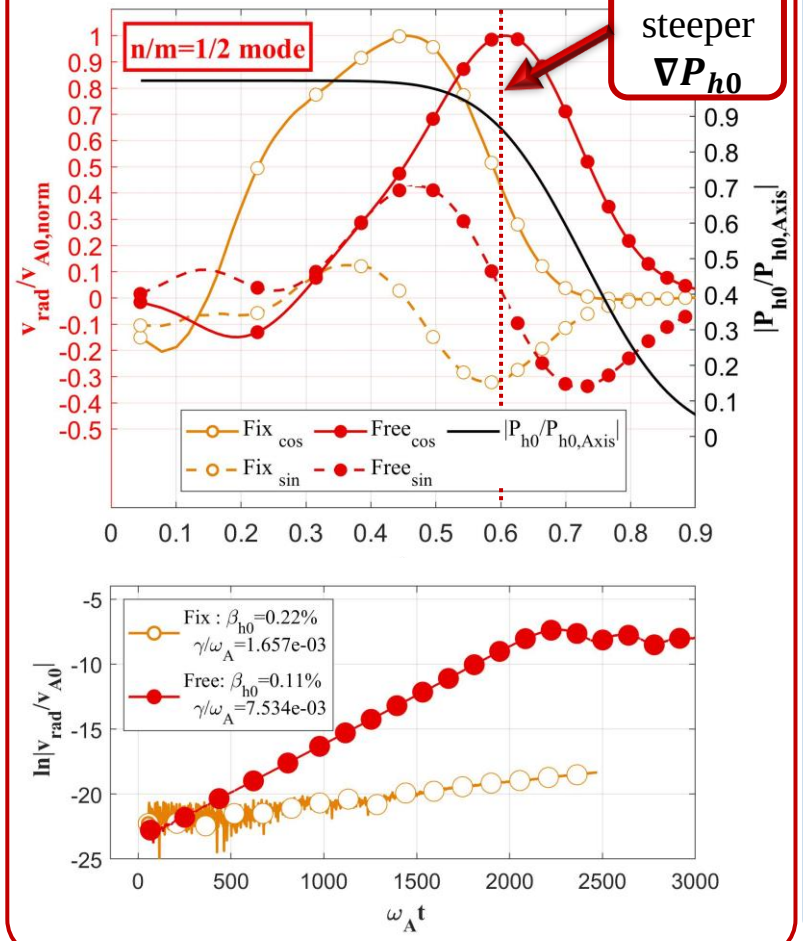
❖ Core-localized Gradient ($\nabla f_{h0,core}$)

➢ The effect of the boundary condition is **negligible** for the core-localized mode.

❖These results suggest the importance of the boundary condition in Heliotron J.
- It might also be applicable in **other low shear devices**.

[1] Adulsiriswad P. et al., *Nuclear Fusion*, **60**(9), 096005.
[2] Adulsiriswad P. et al., *Nuclear Fusion*, **61**(11), 116065.

Edge-localized Gradient ($\nabla f_{h0,edge}$) n/m=1/2 EPM is dominant



Core-localized Gradient ($\nabla f_{h0,core}$) n/m=2/3 GAE is dominant