3D nonlinear modeling of Resonant Magnetic Perturbation on EAST

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ABSTRACT
• 3D MHD equilibrium under RMP is solved on EAST by the nonlinear resistive HINT code [1].
• The pedestal pressure is flatted from modeling result in the RMP penetration phase.
• Self-consistent plasma flow is introduced to simulate the nonlinear interaction between RMP field and plasma rotation, resulting in plasma response in RMP shielding phase.

OUTCOME
3D equilibrium reconstruction in RMP penetration phase

- t=3.9s: no RMP;
- t=4.2s: strong ELM mitigation;
- t=4.5s: ELM suppression.

Almost identical in core region.
- Flatted in the pedestal with RMP.

BACKGROUND
• EAST has been equipped with RMP coil system, asking for 3D equilibrium reconstruction.
• Nonlinear transition between ELM suppression and mitigation is observed with RMP on EAST [2].

METHODS
• The 3D tokamak equilibrium is calculated by the HINT code based on the relaxation method.
• Initial plasma flow is introduced to simulate the nonlinear interaction between RMP field and plasma rotation in the step B:

\[ \frac{\partial v}{\partial t} = -\nabla p + J_1 \times (B_0 + B_z) + \nu \Delta v \]

• RF dominant heating plasma.
- I ~ 10 (kA), V ~ 600V.
- 8 (U) + 8 (L) = 16 coils.
• n=1-3 rotating and n=1-4 non-rotating.

CONCLUSION
To suppress or mitigate ELM strongly, the depth penetration of RMP field or the relevant edge topological change resulting from the nonlinear interaction between RMP field and plasma flow is the key factor from the modeling.

REFERENCES