Low-$n$ Plasma Response to RMPs in DIII-D Discharges 142603

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Only low-$n$ linear plasma response is included in present calculations to avoid distractions from higher-$n$ component growth

- Present study starts with resistive MHD model and Spitzer resistivity profile where $S_{\text{core}} \sim 10^6 - 10^8$ and $S_{\text{edge}} \sim 10^4 - 10^6$, in addition to dissipations such as number density diffusion, kinetic viscosity, and anisotropic heat conductivity.

- $48 \times 96$ finite elements with polynomials of order 5 in poloidal domain, $0 - 3$ toroidal Fourier components are included in the calculations.

- Static EFIT equilibrium is considered here.
DIII-D discharge 142603 has been subject of a 3D equilibrium benchmarking project [Courtesy of Turnbull]
Equilibrium is unstable to middle to high-$n$ edge localized modes in both ideal and 2-fluid models.
I-coil vacuum field is imposed as initial and boundary conditions ($n_{rmp} = 3$, even parity) [Courtesy of Izzo]
The $n = 3$ component of plasma response develops into a linear instability at a higher resistivity ($S \sim 10^6$).
Contours of $n = 3$ component of plasma response show well-resolved ballooning-like mode structures.
Equilibrium is unstable to $n = 3$ edge localized modes in resistive regime.

\[ \gamma = 0.66925 \times 10^3 \text{s}^{-1} \]

\[ \text{ho_d3080914x01} \]
Contours of $n = 3$ component of perturbation show well-resolved resonant mode structures
$n = 3$ component of magnetic response grows linearly and separately from kinetic response.

\[
\gamma = 1.77295 \times 10^3 (s^{-1})
\]

response energy

- $n=3$ kinetic energy
- $n=3$ magnetic energy
For lower resistivity ($S \sim 10^8$) dominant growing magnetic perturbation localized near near wall
Summary and discussion

- $n = 3$ component of linear plasma response to RMPs grows linearly instead of reaching steady state.
- Growth rates of $n = 3$ component of linear plasma response and corresponding spatial pattern rely on resistivity regime.
- Optimal resistivity and dissipation parameter regime is to be determined for benchmarking purpose.