Progress on analyzing impact of partial NCC on infinite-n ballooning

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Co-authors

and the NSTX Research Team

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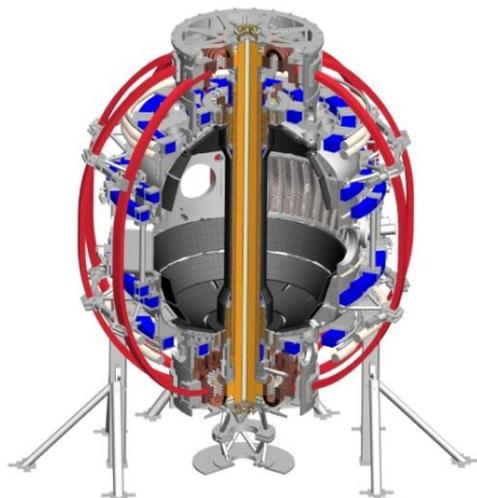
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Fields from full NCC added to generate 3D VMEC equilibrium

- Full NCC considered: 12 coils each in U and L rows
  - The VMEC runs shown here are for n=3 applied, even parity
  - Should check the spectrum I have here against J-K to see if I have the coils implemented correctly
- VMEC rerun with NCC turned on (1kAt), p/q profiles unchanged
  - Yields nonaxisymmetric surface displacements of order ~1 cm

$b_r^{n=3}$ (G)

Toroidal distortion at OMP
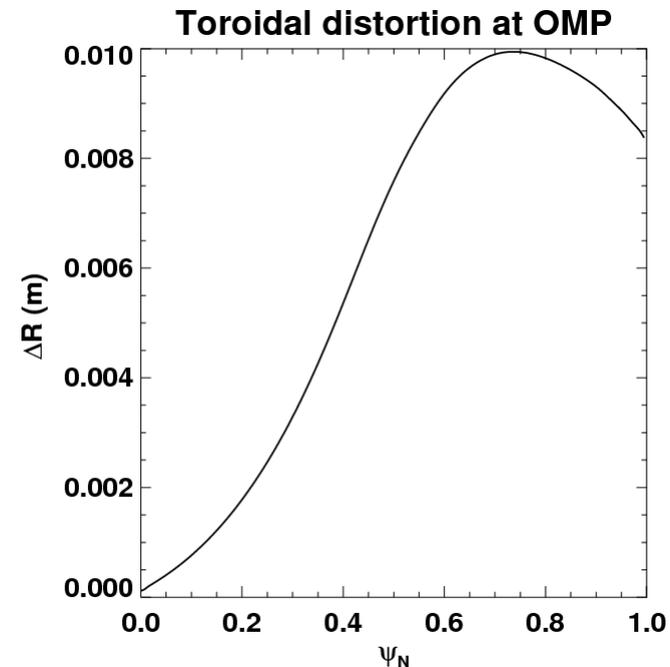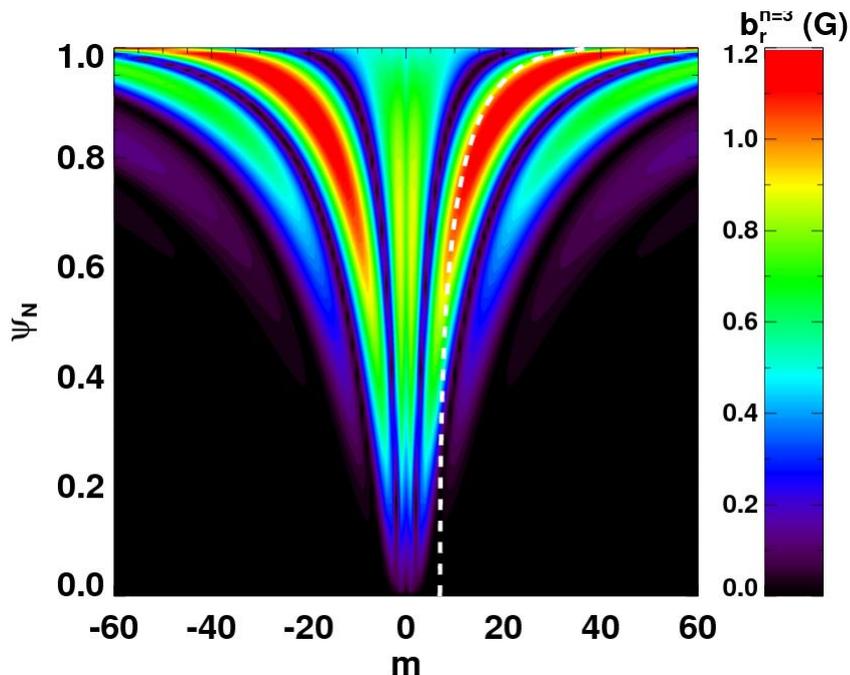
COBRA indicates that full NCC has a large effect on ballooning stability

- Large edge region is unstable with NCC turned on

- Much larger effect than increasing pressure in 2D equilibrium

- Also much larger than effects of RWM coils, even with lower coil current

- Partially due to nature of 2D equilibrium chosen, with broad region of near-instability

Legend (upper plot): 2D, NCC n=3 1kAt, RWM n=3 2kAt, 2D 1.1*Pressure. Axes: γ/ω_A vs ψ_N.

Legend (lower plot): Experiment, First Stab., Second Stab., $|\beta'|$ at min s. Axes: $|\beta'|$ vs rhoc.
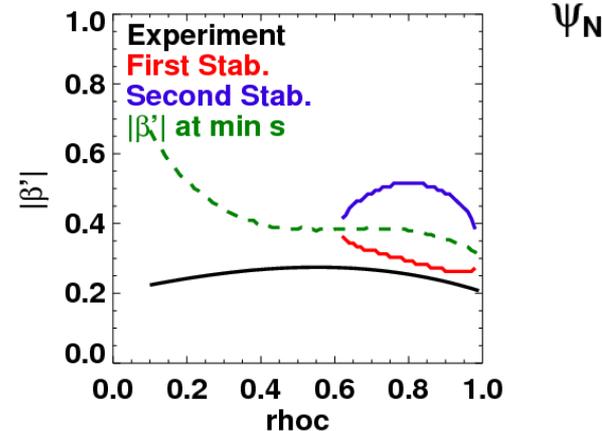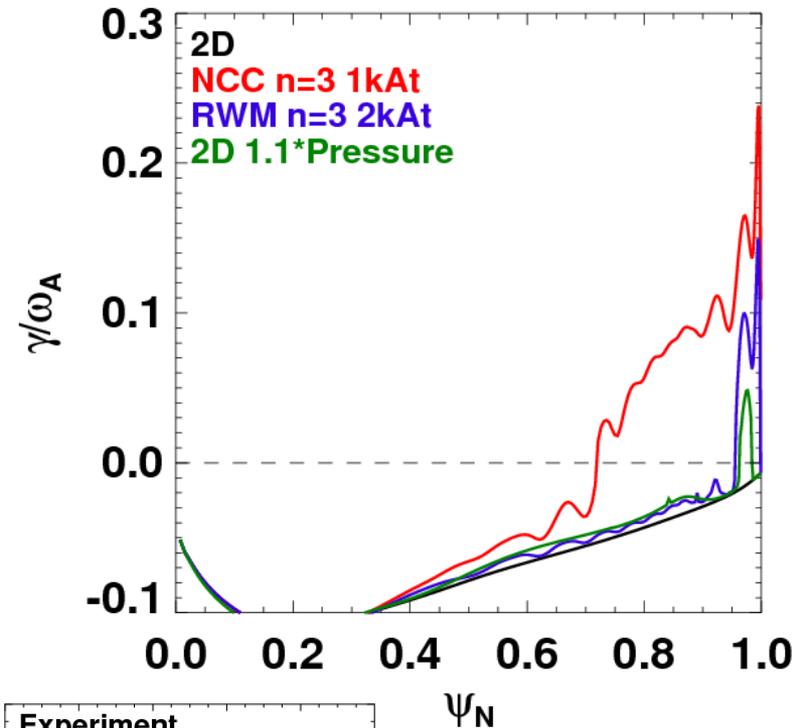
Partial NCC implemented in new VMEC runs

- 6 coils each in U and L rows, but staggered
  - n=3 always considered here
  - Two helicities considered, depending on up-down phasing
  - One is dominantly resonant (more-so than full NCC), the other non
- Very preliminary results; little in the way of sanity checks done
  - No resolution scans (ns=99, ntor=3*3, mpol=30)
  - Haven't checked dB spectrum from VMEC runs (as opposed to vacuum)
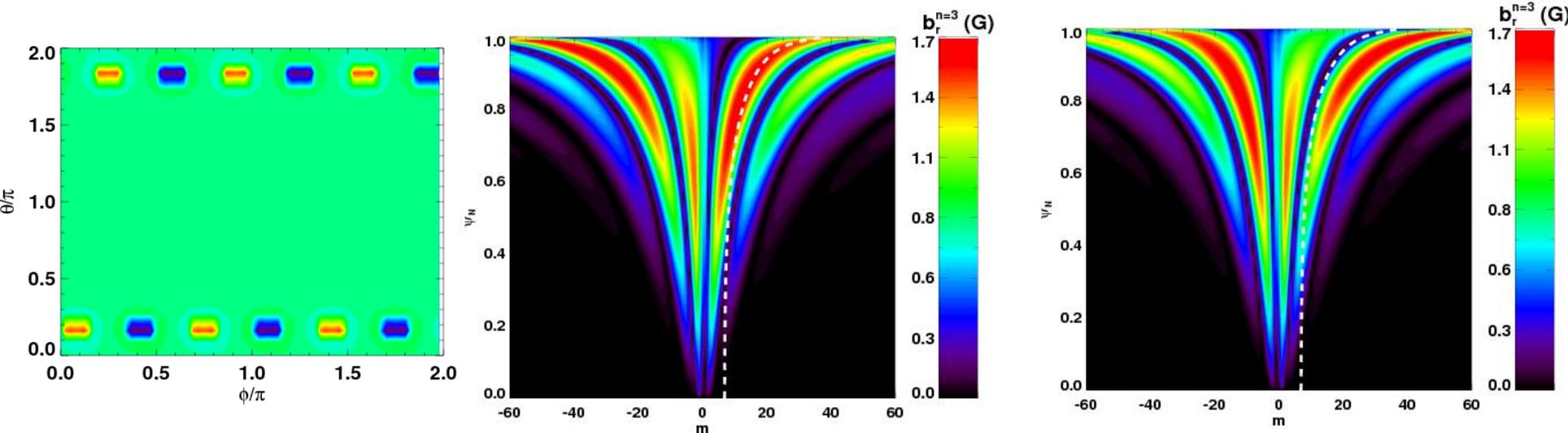
Impact on ballooning stability is more modest than full NCC

- With 1kAt, partial NCC has small impact on ballooning
  - Small, positive growth rates very near edge
- Increasing to 2kAt gives larger change in gamma
  - Instability still restricted to $\psi_N > \sim 0.95$
  - More like RWM coils than full NCC
  - Not much difference between two helicities
- Related to kink-resonant perturbation?
  - Full NCC strongest (by eye…)
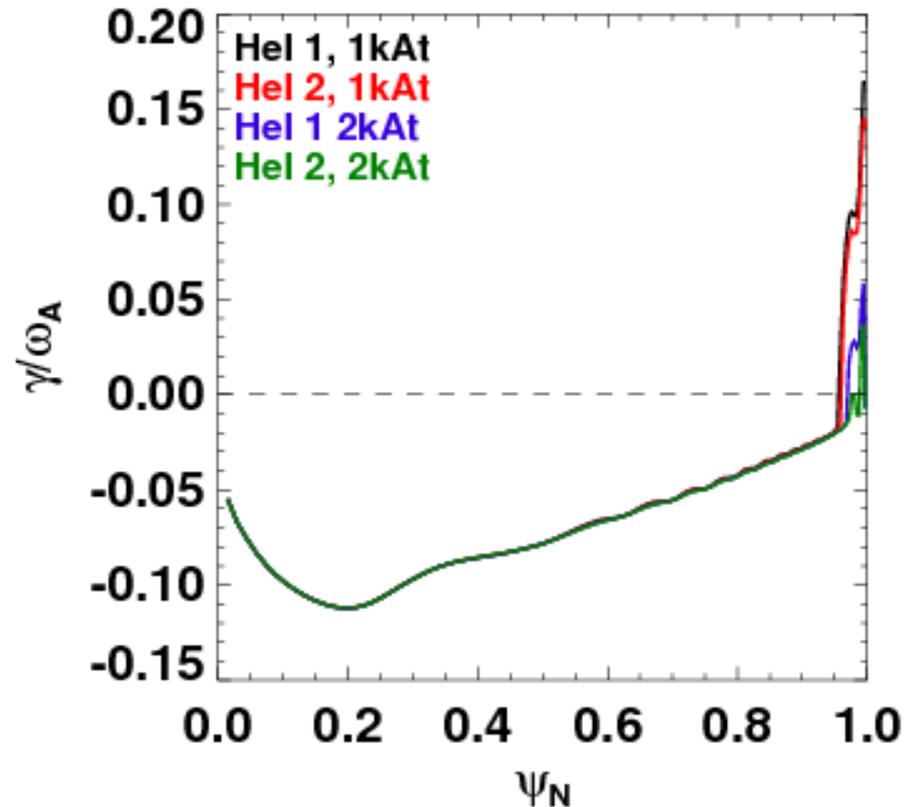
NCC moves the stability boundary at s=0.8 (ψ_N=0.903)

- COBRA/VMEC agree well with BALL code in axisymmetric case
  - Red contour is stability boundary from ball, based on g-file
  - Color contours are from shear/P' scans using VMEC/COBRA
- Shift in stability boundary when NCC fields are applied is clear
  - BALL boundary is unchanged-shown for reference
  - Boundary moves both in shear and pressure gradient
  - In this case, nominal profiles (white plus sign) goes from stable to unstable (consistent with previous slides)