Plasma Configurations

Talk for NCSX Project Meeting
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Progress on Configuration Design Since Last Project Meeting

- Terpsichore vertical stability benchmarked, and evaluated for c82. Configuration c82 is stable.
- New matrix inversion routine that allows larger number of Fourier modes incorporated in Terpsichore ballooning code. Convergence problems near edge resolved.
- Detuning in Mercier and ballooning codes removes resonance effects, which had caused problems for optimization.
- New configuration identified (c93) with lower sheet current, comparable kink stability.

Proposed Near Term Configuration Plan

Near term emphasis on validation of reference design.

I. Bootstrap current. If magnitude of current larger than we are assuming, kink stability will be a problem.

   A. Establish consensus on reasonable assumption for bootstrap current.
      Use reactor relevant bootstrap profiles, rather than profiles expected in experiment?
      What n and T profiles are reasonable?
   B. Resolve discrepancies between codes.
   C. Investigate effect of varying n and T profiles on self-consistent bootstrap current. What is the range of currents consistent with bootstrap? How small a current is it reasonable for us to use?
   D. Self-consistent bootstrap with reasonable seed current profile. Investigate seed current reduction.

II. Ballooning stability.

A. Modify p' profile to stabilize ballooning.
B. Verify self-consistent bootstrap current with p' modification for ballooning. Do things unravel when we decrease p' at edge? NEED RESOLUTION OF BOOTSTRAP ISSUES FIRST FOR THIS.
C. ORNL validation of ballooning stability.

III. Vertical and Kink Stability.

A. Elongation dependence of vertical stability. How large an elongation is stable?
B. Benchmark vertical and kink stability against CAS3D calculations.
C. Benchmarking between Terpsichore pseudoplasma and Green's function approaches.

IV. Profile and robustness issues.

A. Kink β limit vs profile and magnitude of current.
B. What profiles are reasonably consistent with transport calculations?
C. What profiles are suggested by stellarator experience?

V. PIES evaluation of flux surfaces.

   A. Evaluate xerror improved current sheets with VMEC plasma currents.
   B. Self-consistent plasma currents. Include bootstrap current effects (longer term).

VI. Further configuration optimization for improvement of in-PBX configuration and for reactor scenario.

   A. Can we improve things by taking advantage of increased elongation allowed by vertical stability?
   B. Configuration optimum vs. aspect ratio.
   C. Need improved treatment of transport in optimizer.

First Cut at PVR Chapter Outline and Assignments

I. Introduction. The Reference Design Configurations. Reiman.

II. Configurations examined in startup, robustness, and flexibility studies. Ku.

III. Quasi-axisymmetry properties of the configurations. Ku or Reiman.

IV. Bootstrap Self-Consistency. Monticello.

V. Ballooning stability. Ku and Reiman.

VI. Kink and vertical stability. Fu.