Progress in Configuration Development

- C10 is not kink stable, but coils are OK. C82 is kink stable, but the maximum coil current density may be too high. For both cases, there are uncertainties about the bootstrap current, and the confinement of energetic particles is poor.

- To improve C10/C82 with respect to the kink stability and coil current density, we ask

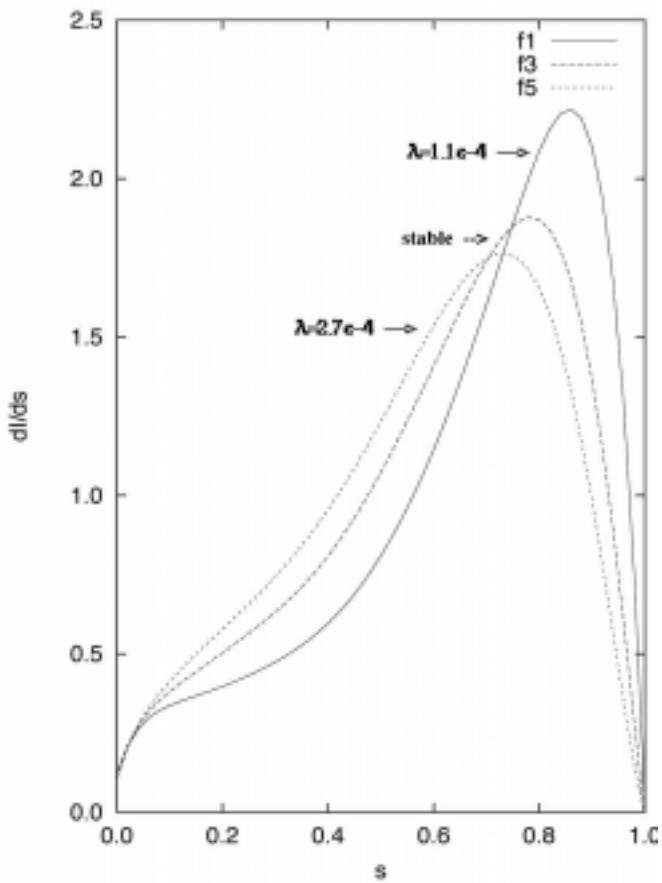
  – For C10, are there more favorable current profiles for the kink stability at Ip=200 kA level?

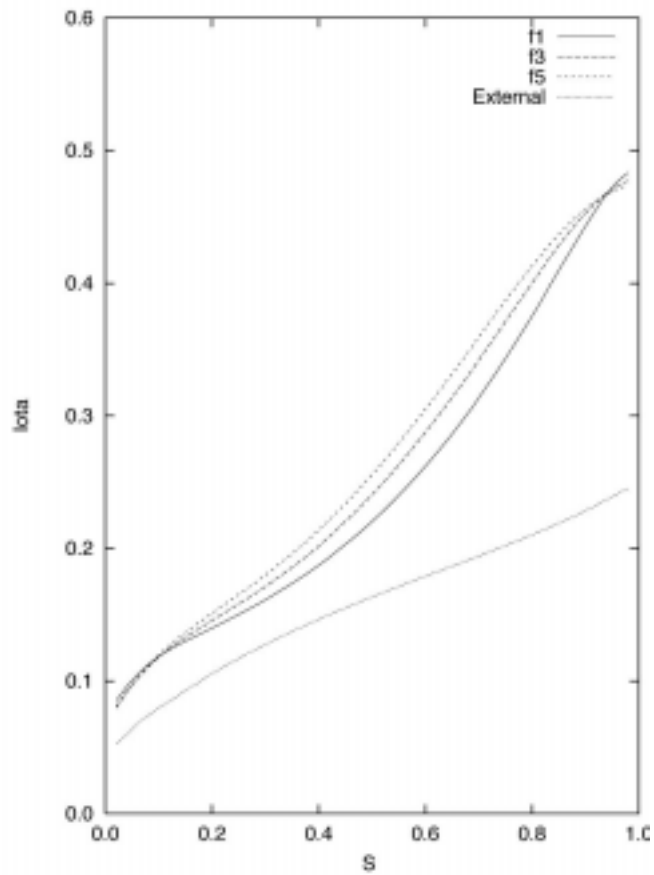
  – Starting from C10 boundary but at a lower plasma current, can we stabilize the kink with less surface deformation so as to make coil designs easier (using the reference p and Ip profiles)?

– Between C10 and C82, is there an intermediate configuration that may be a good compromise and that serves as a new starting point for further optimization?

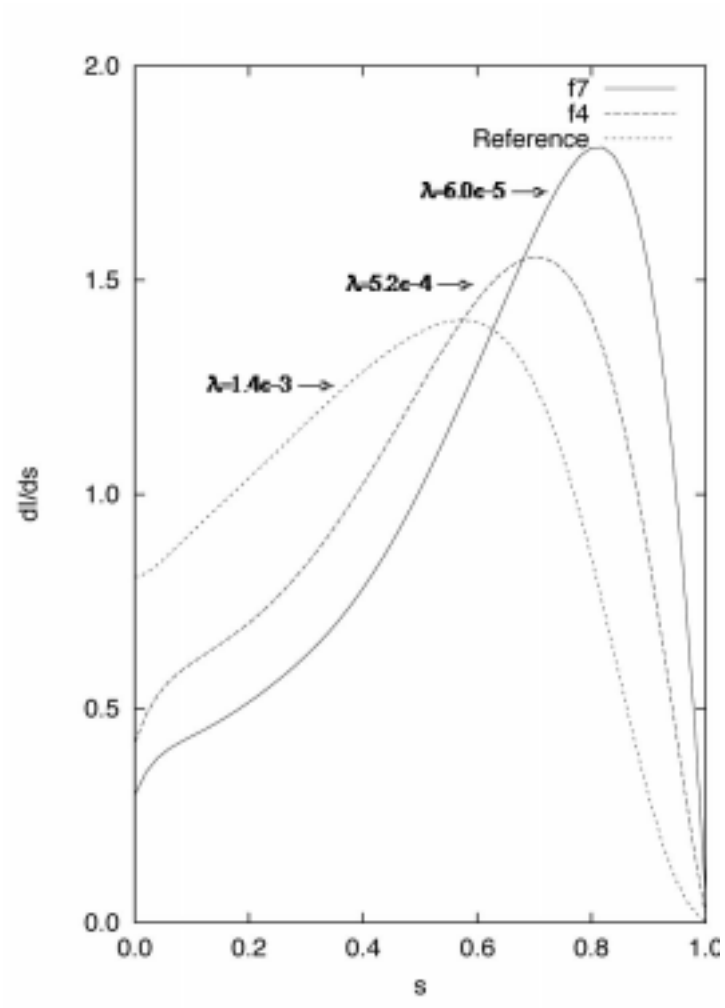
A. Study of the effects of self-consistent current profile

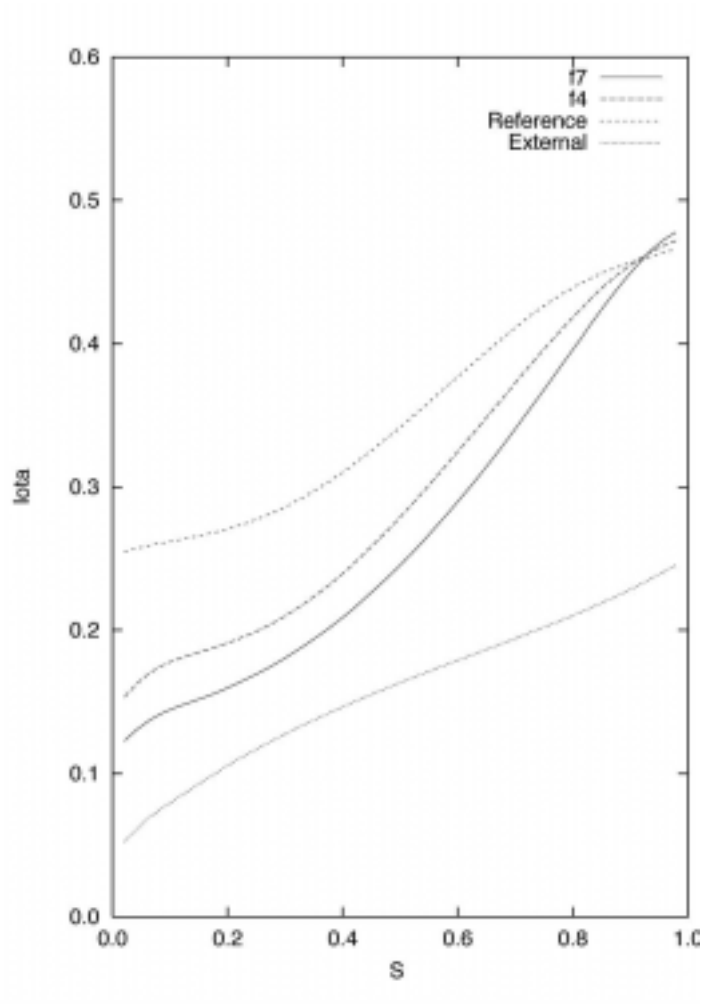
- Broad pressure profiles which shift the peak of the bootstrap current density outward tend to reduce the kink growth rate in C10.



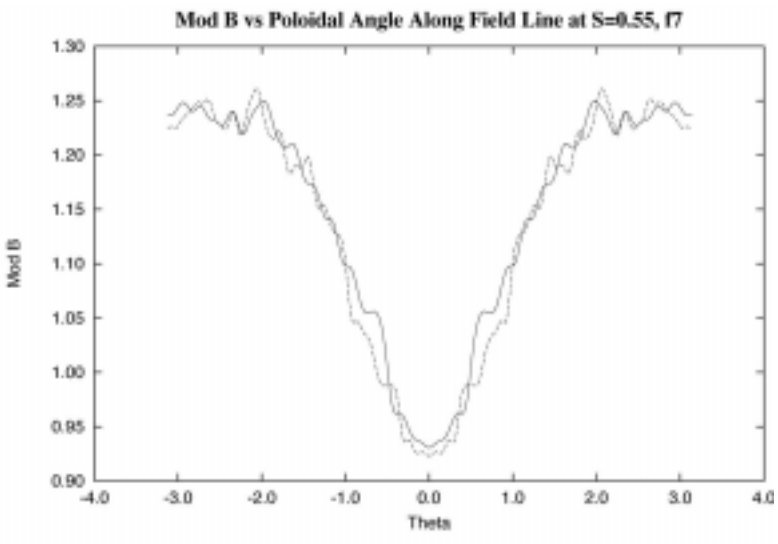


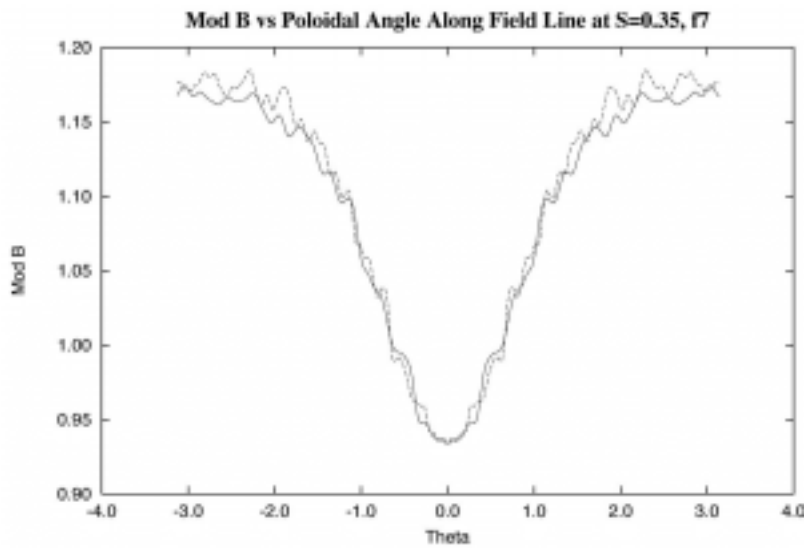
more examples:





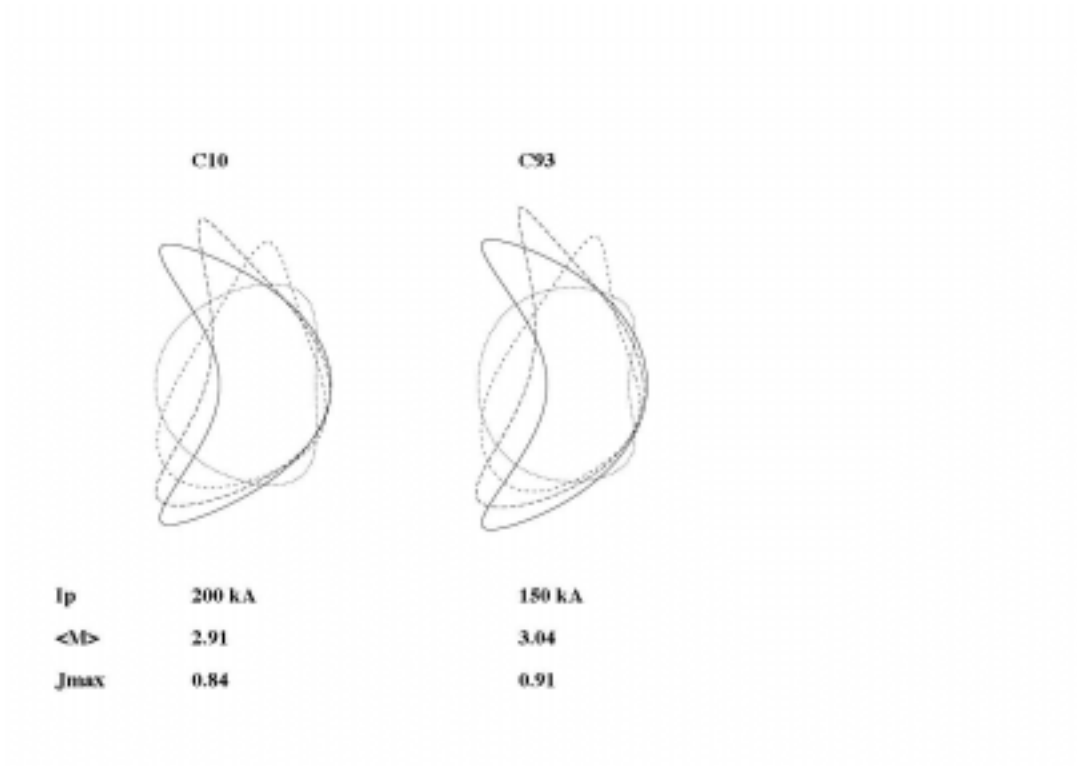
- Clearly, it is possible to choose a pressure profile that would make C10 marginally stable to kinks. The issue is quasi-axisymmetry, since C10 was optimized for a particular pressure and current profile.





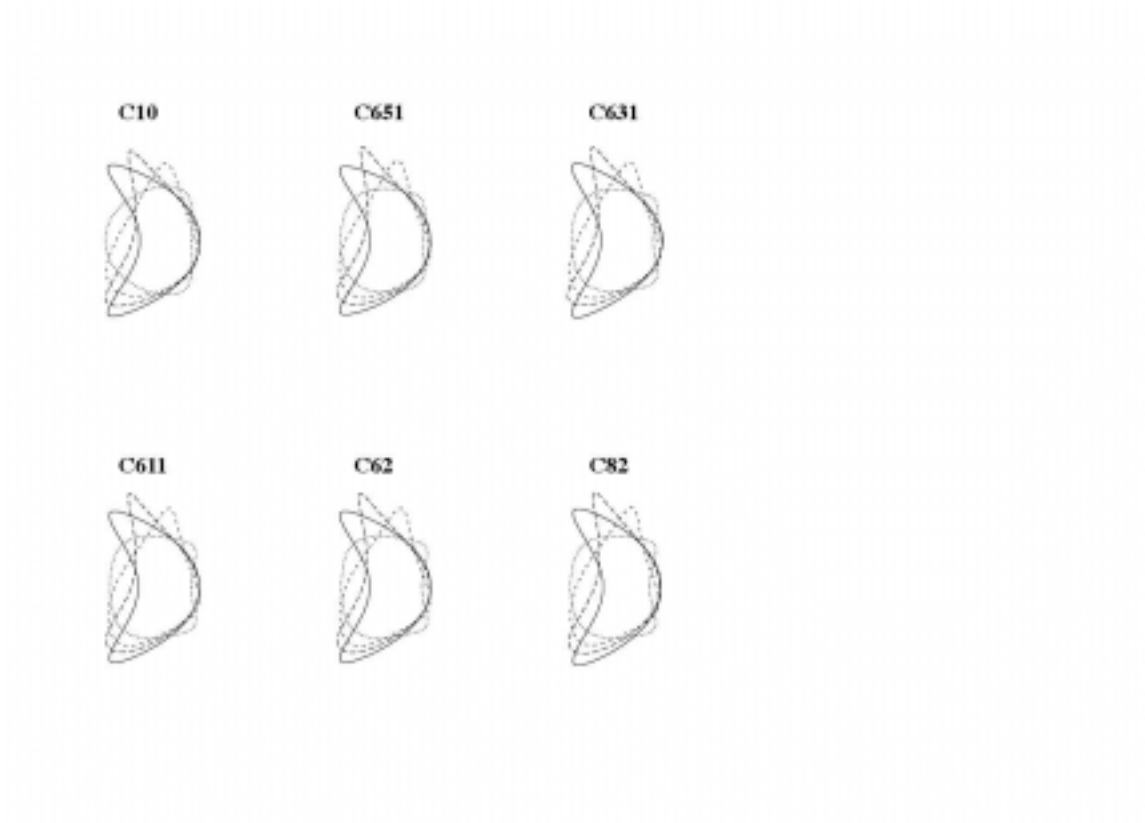
B. Re-stabilize C10 with a reduced plasma current

- Re-stabilization of C10 at 150 kA, using the reference pressure and current profiles, leads to C93 with a moderate increase in maximum coil current density and complexity, but the QA needs much improvement.

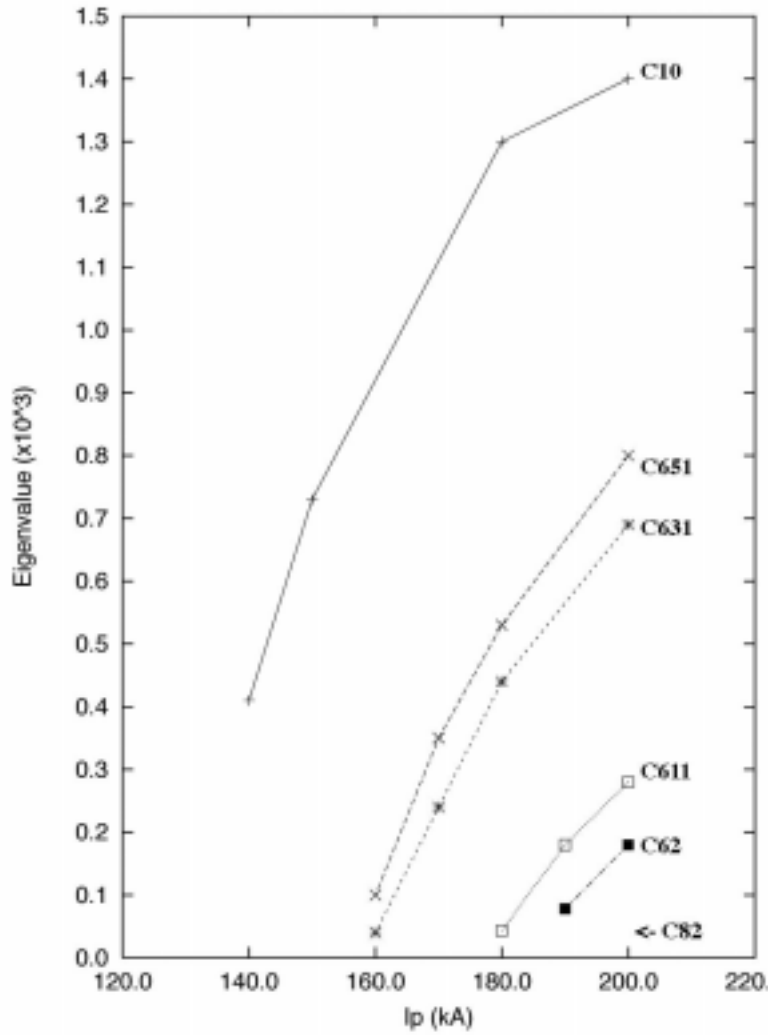


C. Study of configurations between C10 and C82

- Boundary shapes of a sequence of equilibria. The configurations become more kink stable from top left to bottom right.



- Critical plasma current for the kink stability.

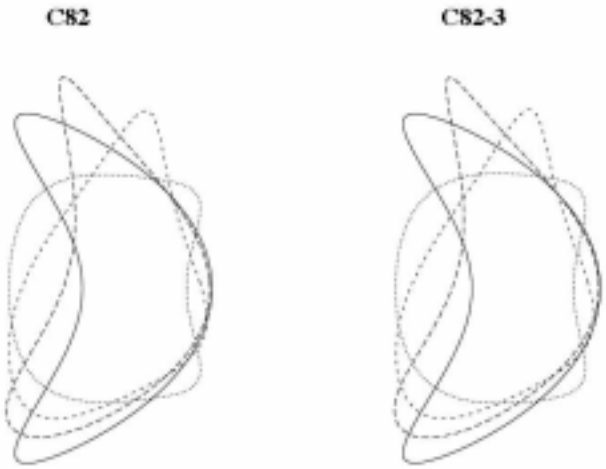


Comparison of measures of QA and coil complexity

(Coil surface offset: 18 cm)

Case	$\chi 2$ Bmns	Jmax/Ipol	Jave/Ipol	<M>	ε max (%)	ε ave (%)
C6	0.010	0.96	0.20	3.29	4.68	0.16
C10	0.020	0.84	0.20	2.91	2.41	0.14
C651	0.036	1.19	0.22	3.14	3.36	0.19
C631	0.030	1.10	0.22	3.09	2.87	0.18
C611	0.033	1.27	0.22	3.20	3.70	0.23
C62	0.037	1.36	0.23	3.25	3.50	0.23
C82	0.024	1.02	0.21	3.09	3.30	0.22

- C631 may be a good candidate as the new starting point of optimization, but C82 still appears to be the best in the sequence. Can we further improve upon it?



<M>	3.09	3.06
Jmax	1.02	0.98
Emax	3.30	3.73