Recent Results from Control Matrix Explorations

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In earlier reports (12/2/99,1/11/00) on our CM studies, Neil and I described 2 subprojects we intended to pursue:

(a)New, free-boundary application: $\mathbf{Z} = \mathbf{X} \rightarrow \mathbf{I}$. Applying the CM machinery to a new configuration space $\mathbf{Z}$, where instead of the Z_j being the amplitudes X_j describing the plasma boundary, they are now the currents I_j in the external coils, plus perhaps the plasma $\langle\beta\rangle$, and parameters characterizing the profile shapes. Making this transition requires using free- instead of fixed–boundary VMEC.

(b)Understanding the behavior of the optimizer.

Here, we desribe results obtained so far from these 2 efforts.

○Analysis of Optimizer Behavior:

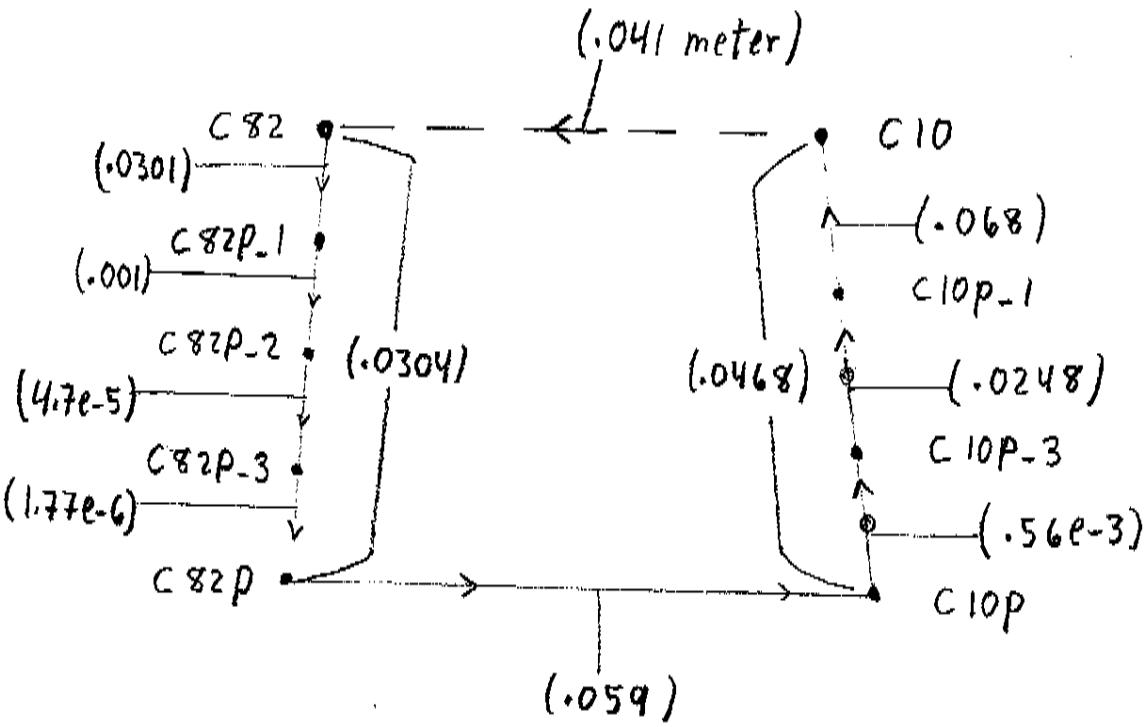
·Long-Poe ran the fixed-bdy optimizer with objective fn $F(\mathbf{P})$ chosen to correspond closely with CM analysis:

$F = P_1/(.0025)^2 + (P_5/10^{-4})^2$.

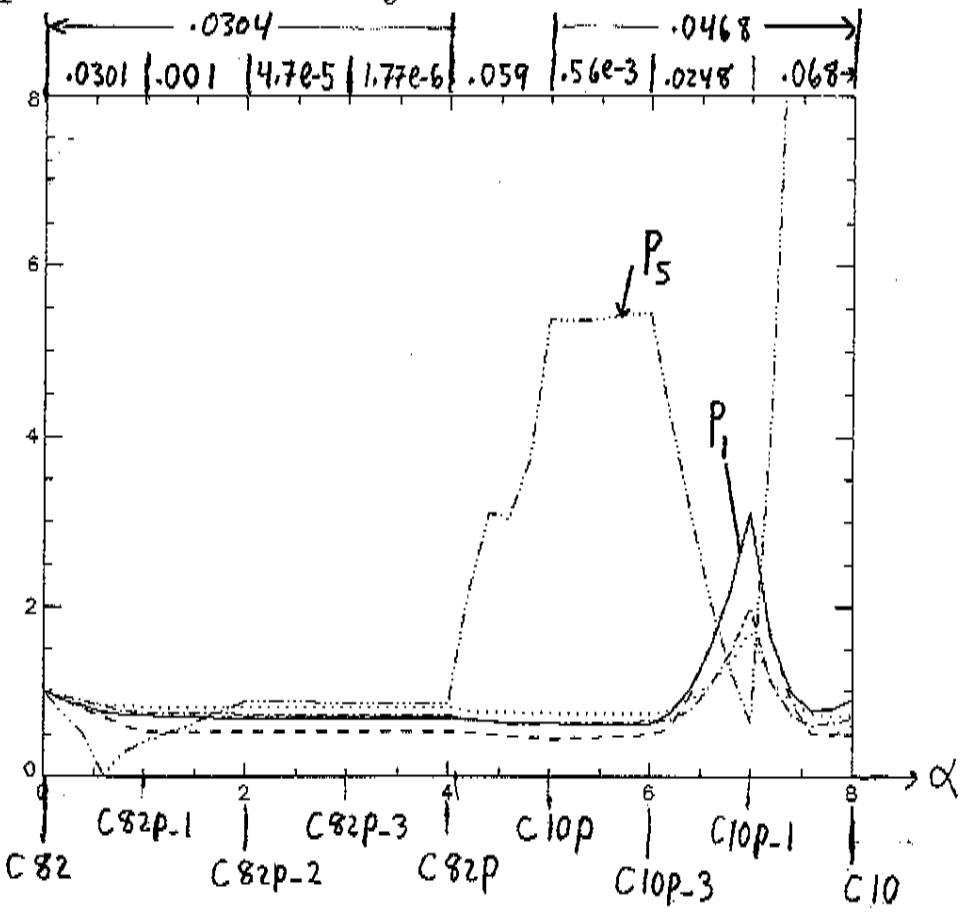
For this F, c10 and c82 no longer minima.

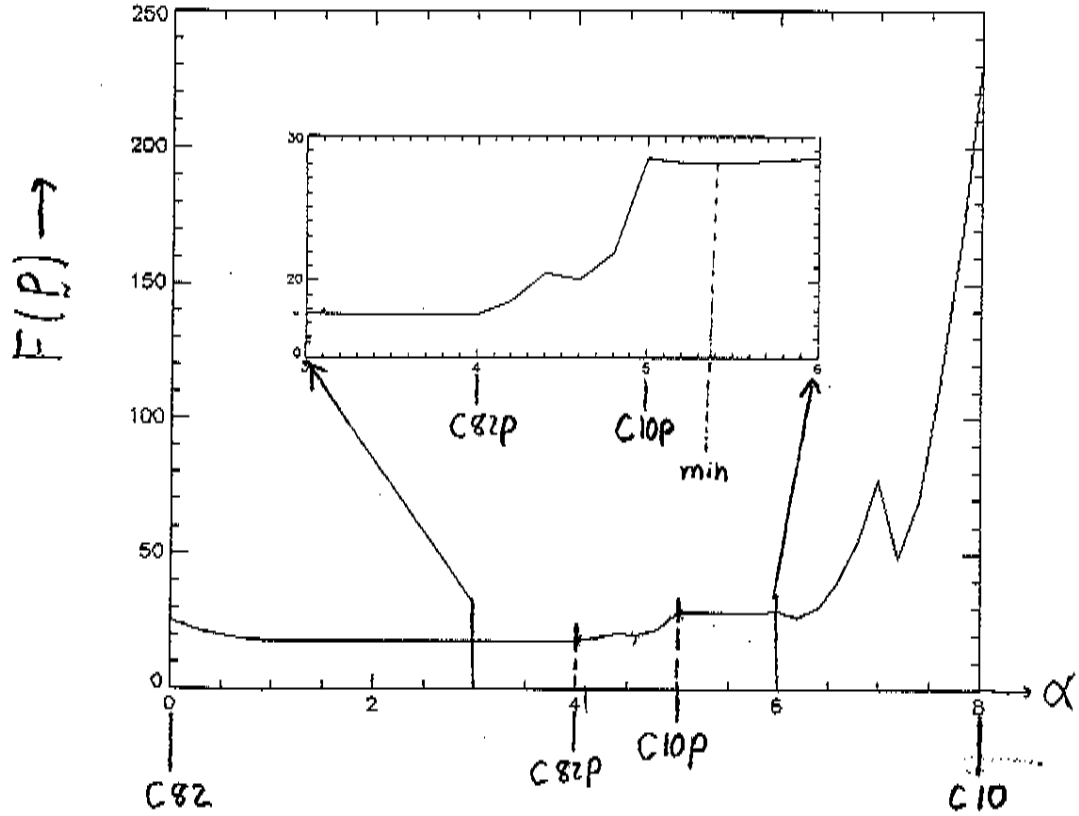
⇒Started at these 2 points c10 = c10p_0 and c82 = c82p_0, optimizer evolves to new minima c10p = c10p_5 and c82p = c82p_4. ·These found to be not the same, implying a 'ridge' should exist in $\mathbf{Z}$ space between c10 and c82.

·See if our 'by-hand' visualization of the optimizer 'trail' indicates the optimizer is working as one would expect.

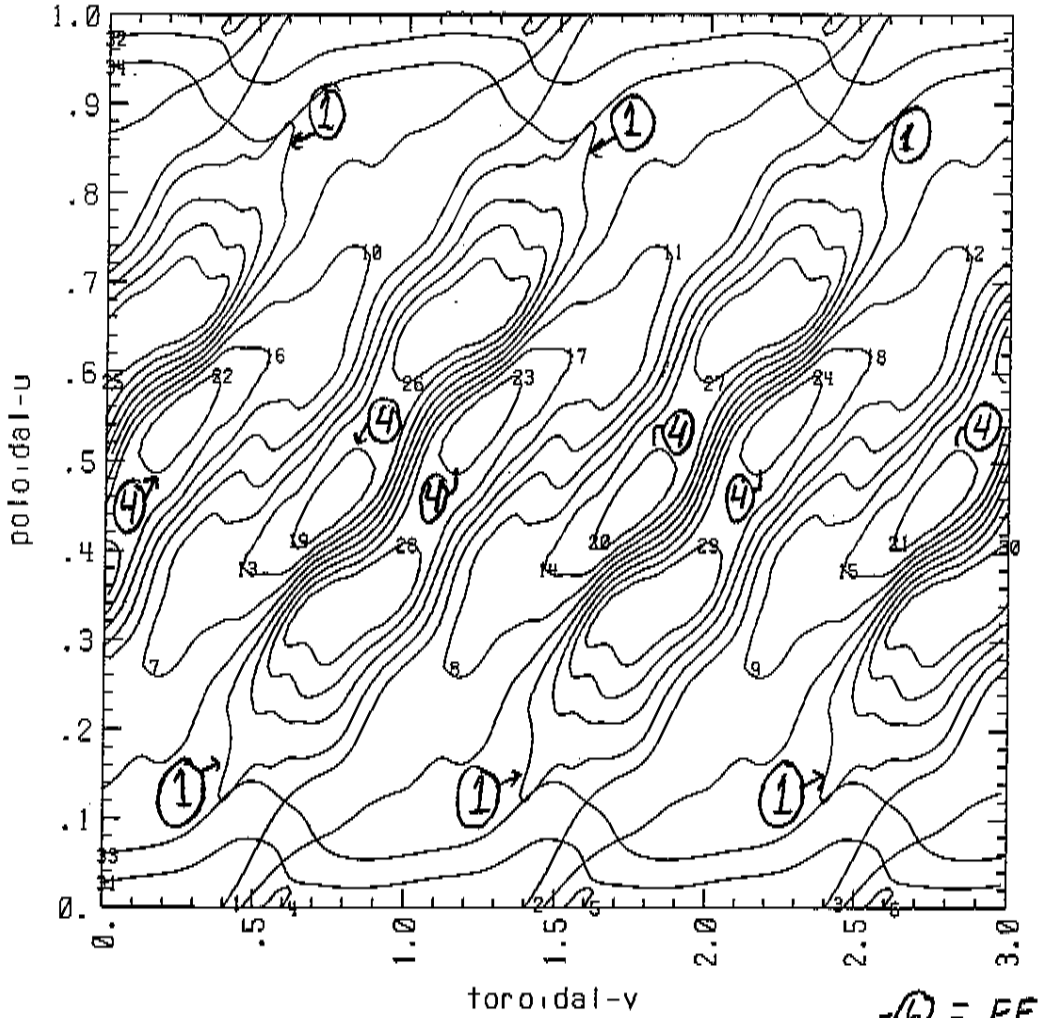


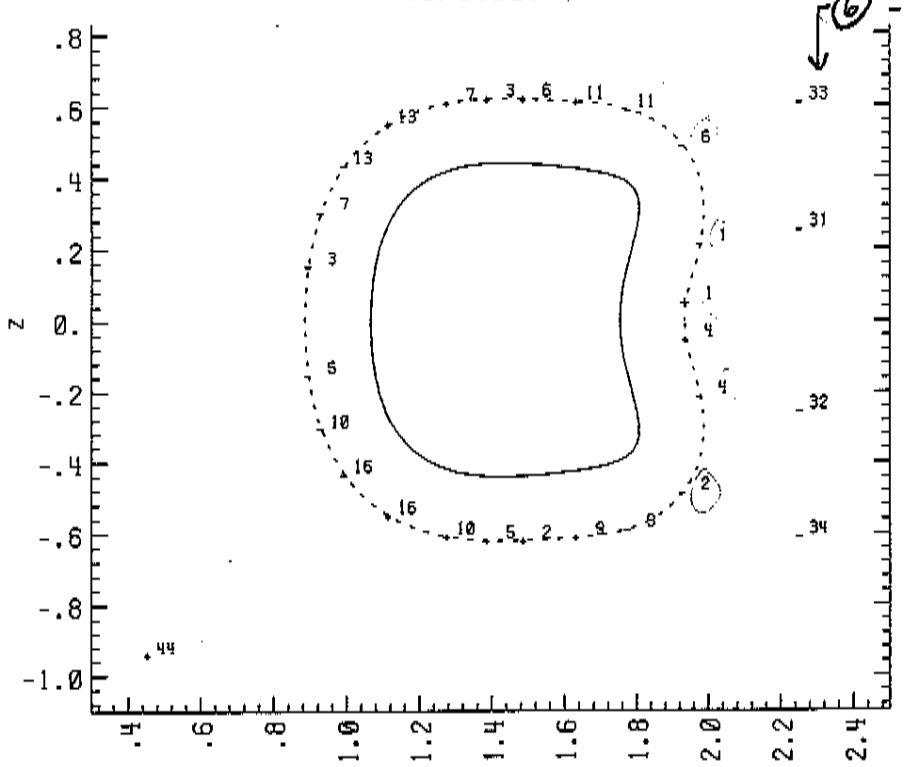
◦Optimizer Analysis: Results:





○Coil set c82.4064_rev6: Neighborhood of C82b

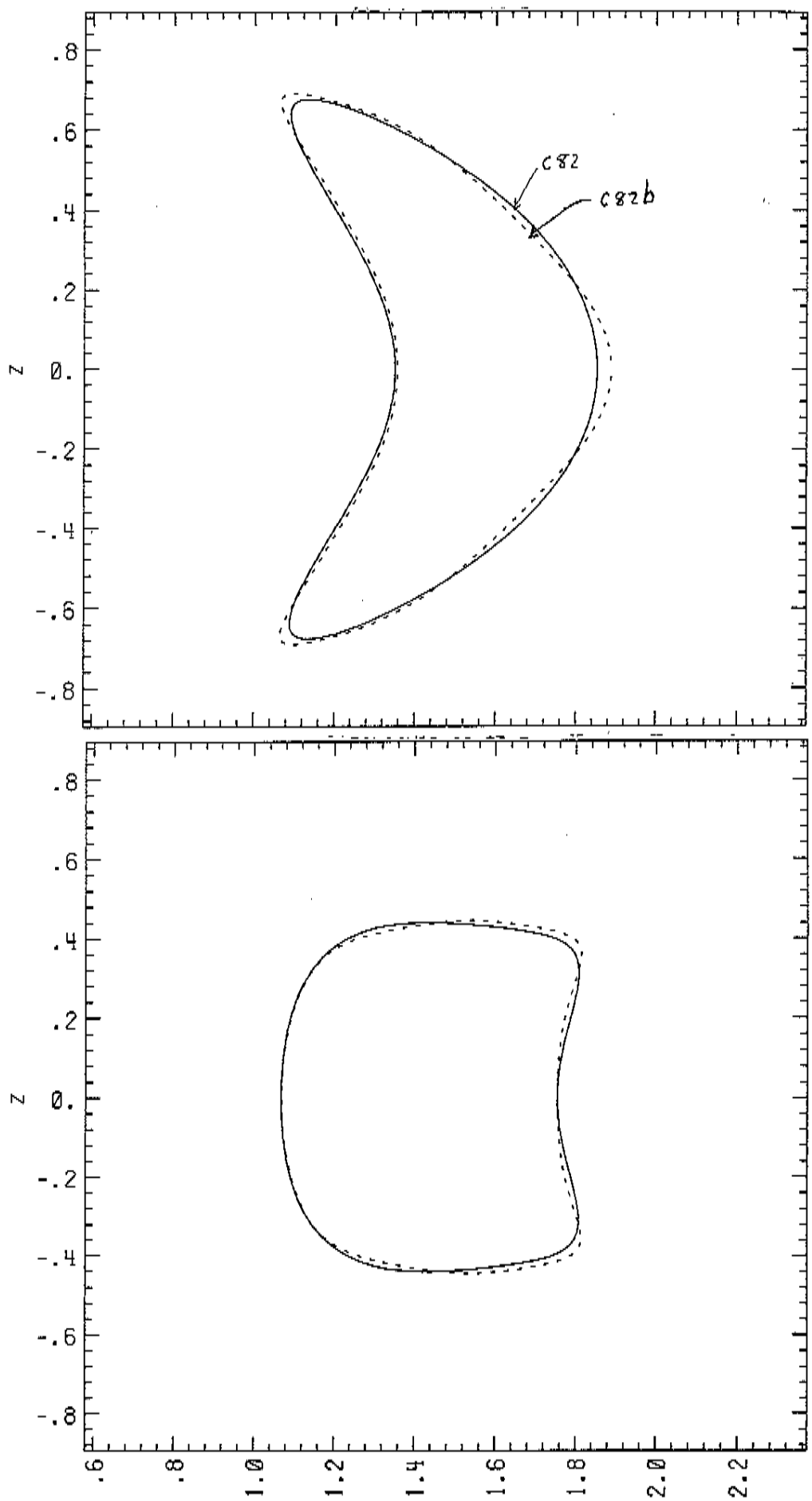




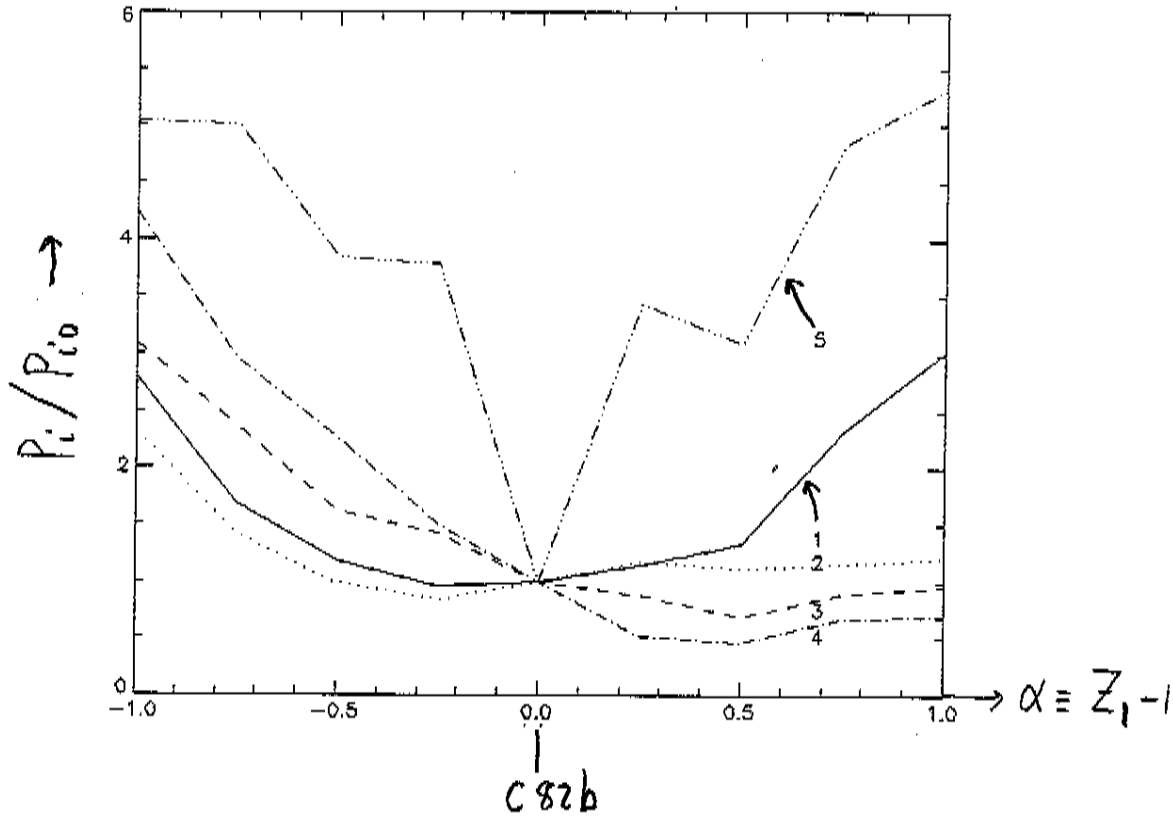
⑥ = EF group

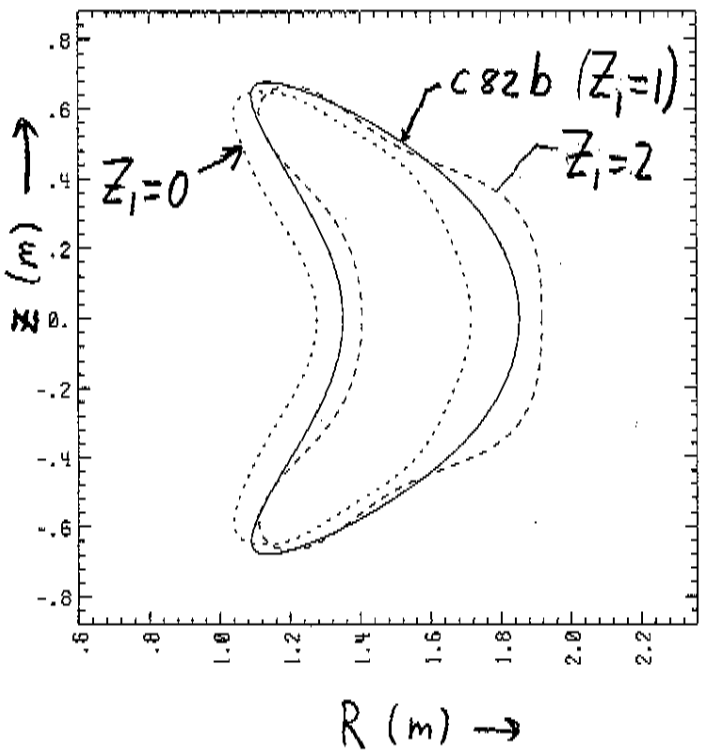
1-6 = group ①

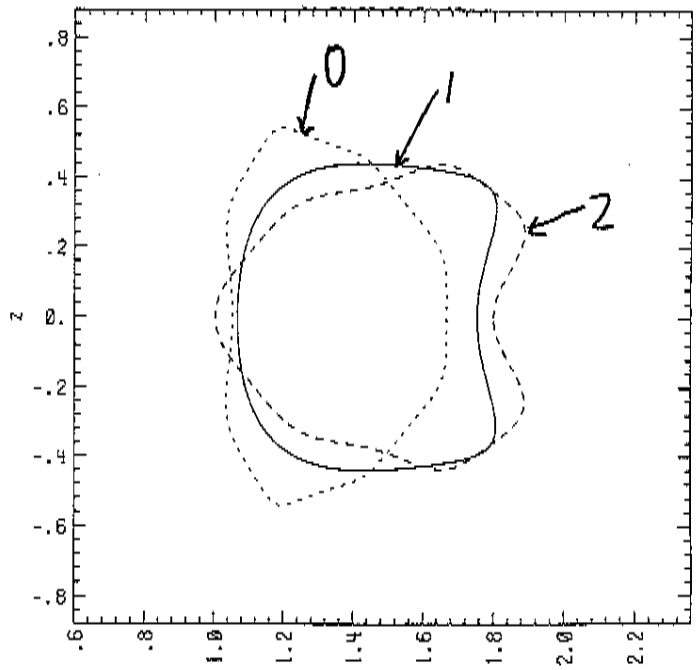
19-24 = group ④


C82
C82b
Z
.8
.6
.4
.2
0.
-.2
-.4
-.6
-.8
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2

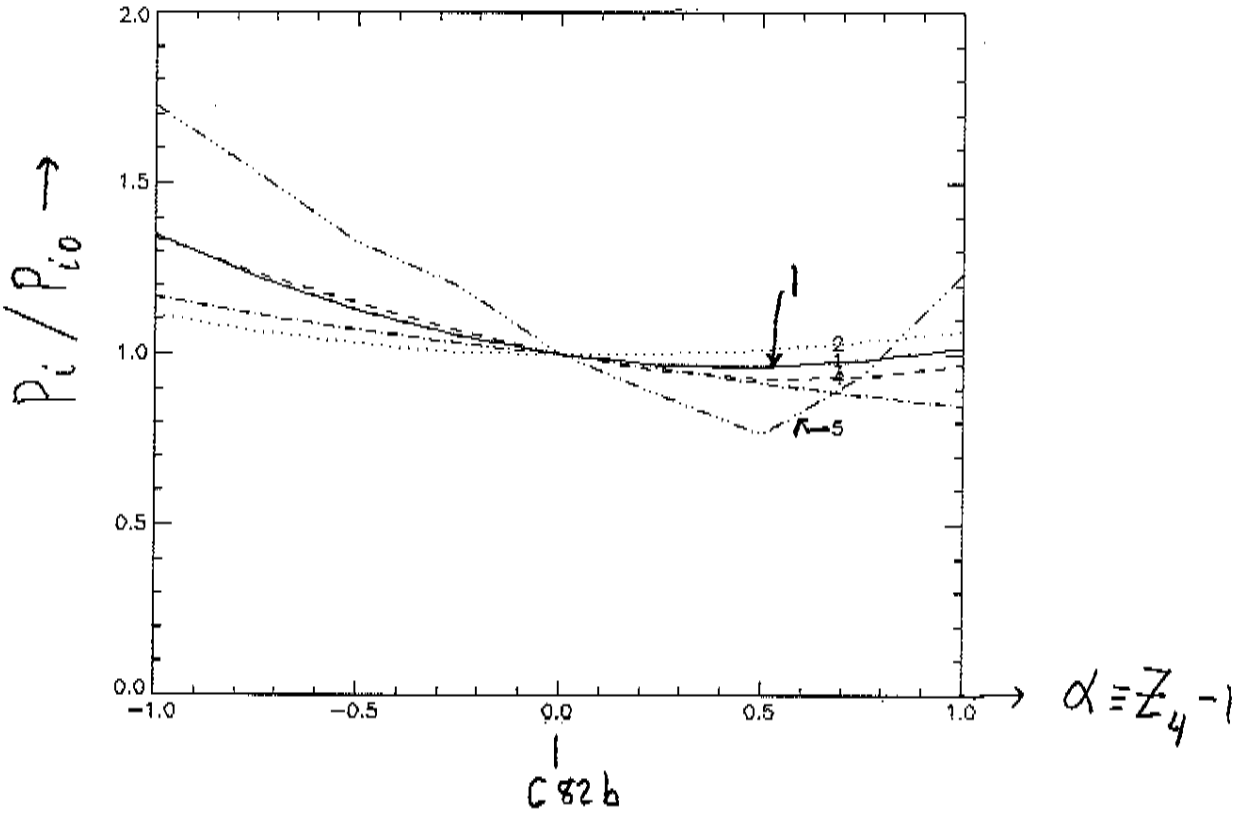
∘Sweep of $Z_1 \equiv I_1/I_{10}, = 0, 0.25, .., 1.75, 2.0.$
Plot $P_{i=1-5}$ vs Z_j. (P_5 uses coec=coep=1.05):

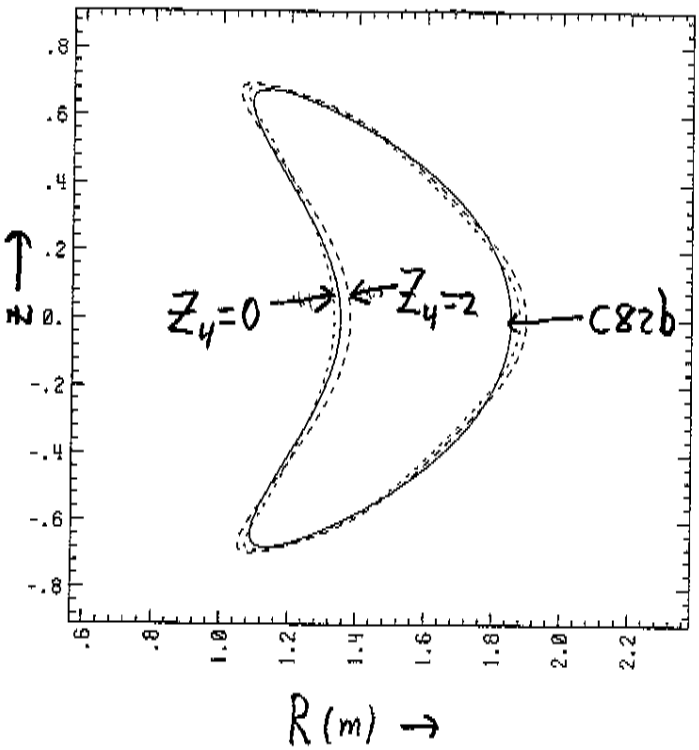


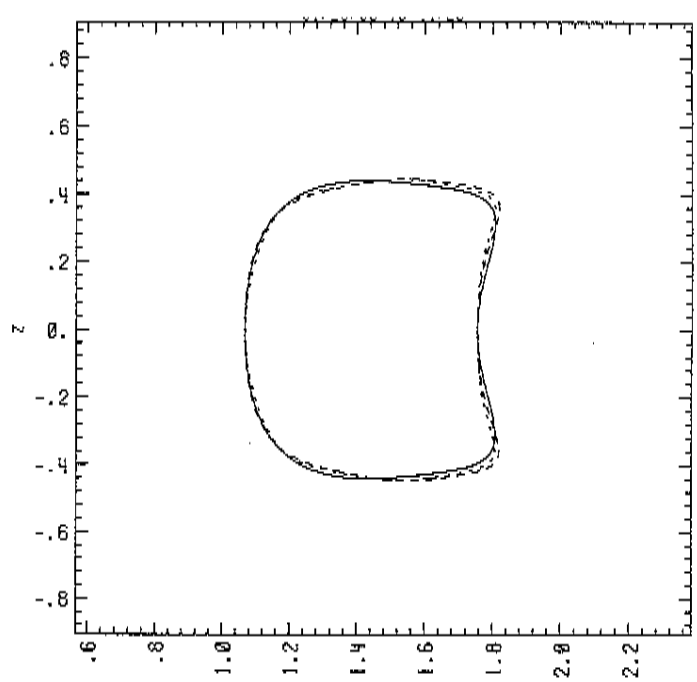




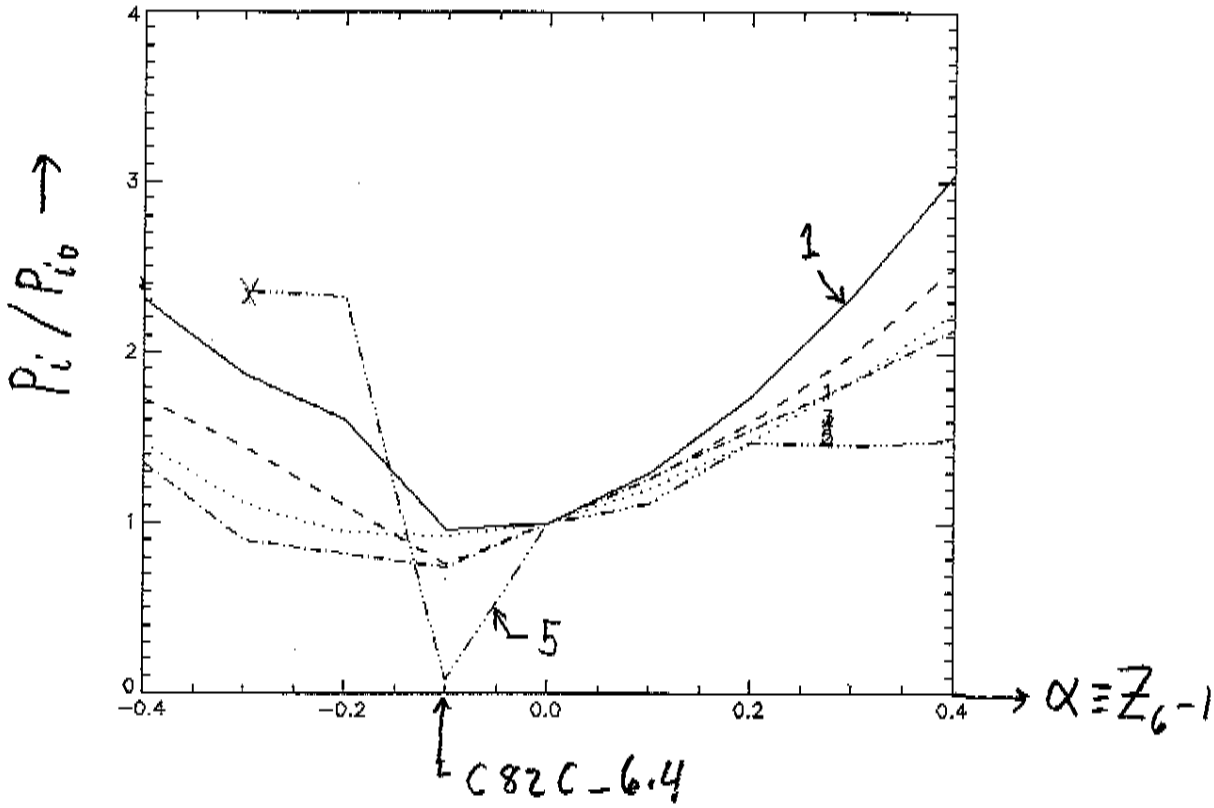
∘Coil group 4: P_i vs $Z_4, = 0, 0.25, .., 1.75, 2.0$:

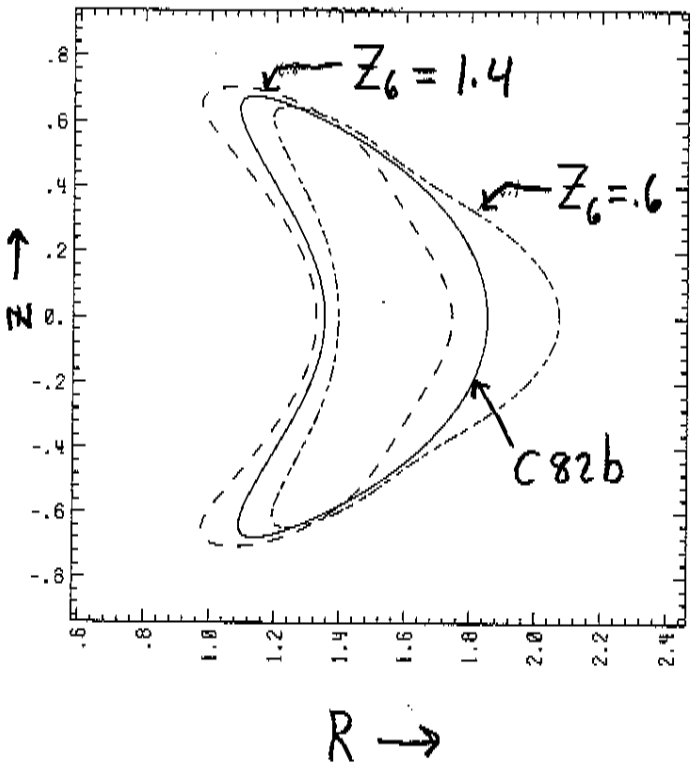


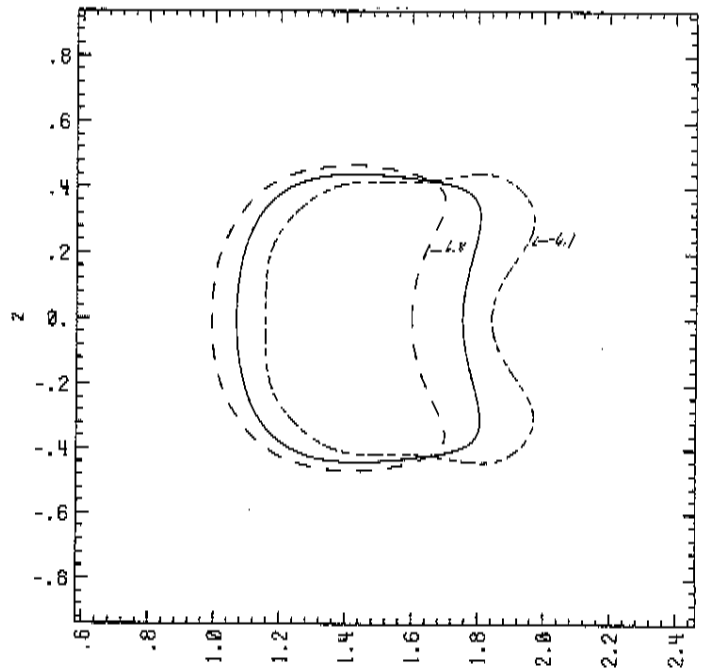




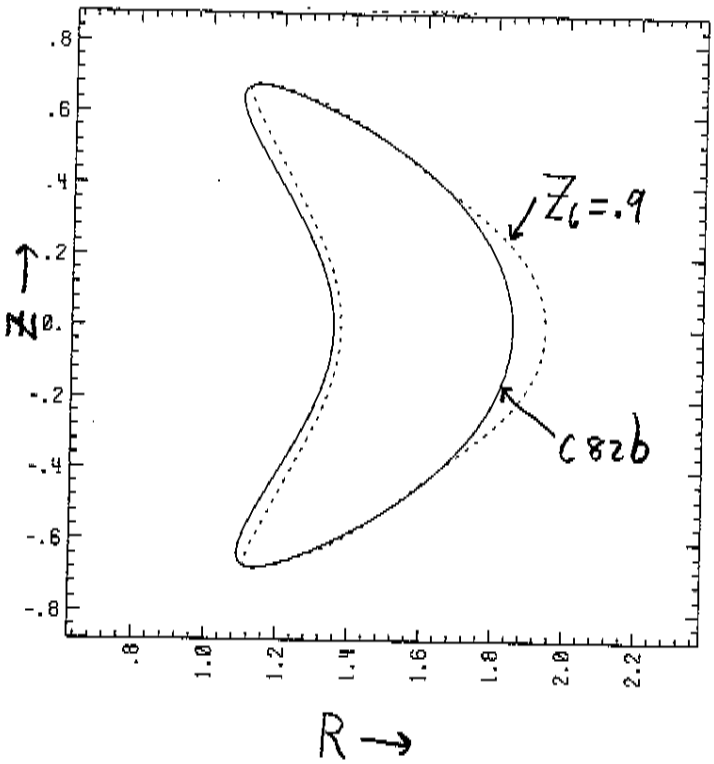
∘Coil group 6=EF coils: P_i vs $Z_6, = 0.6, 0.7, ...1.4$:

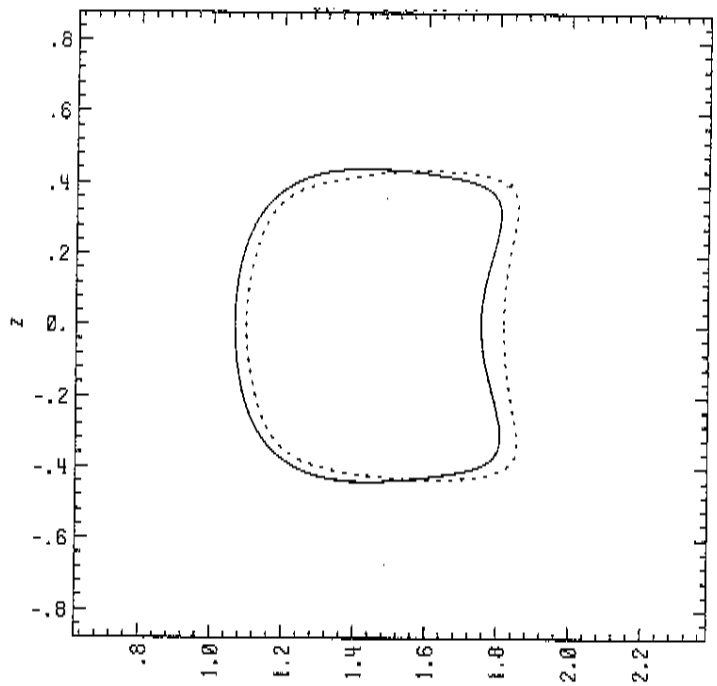






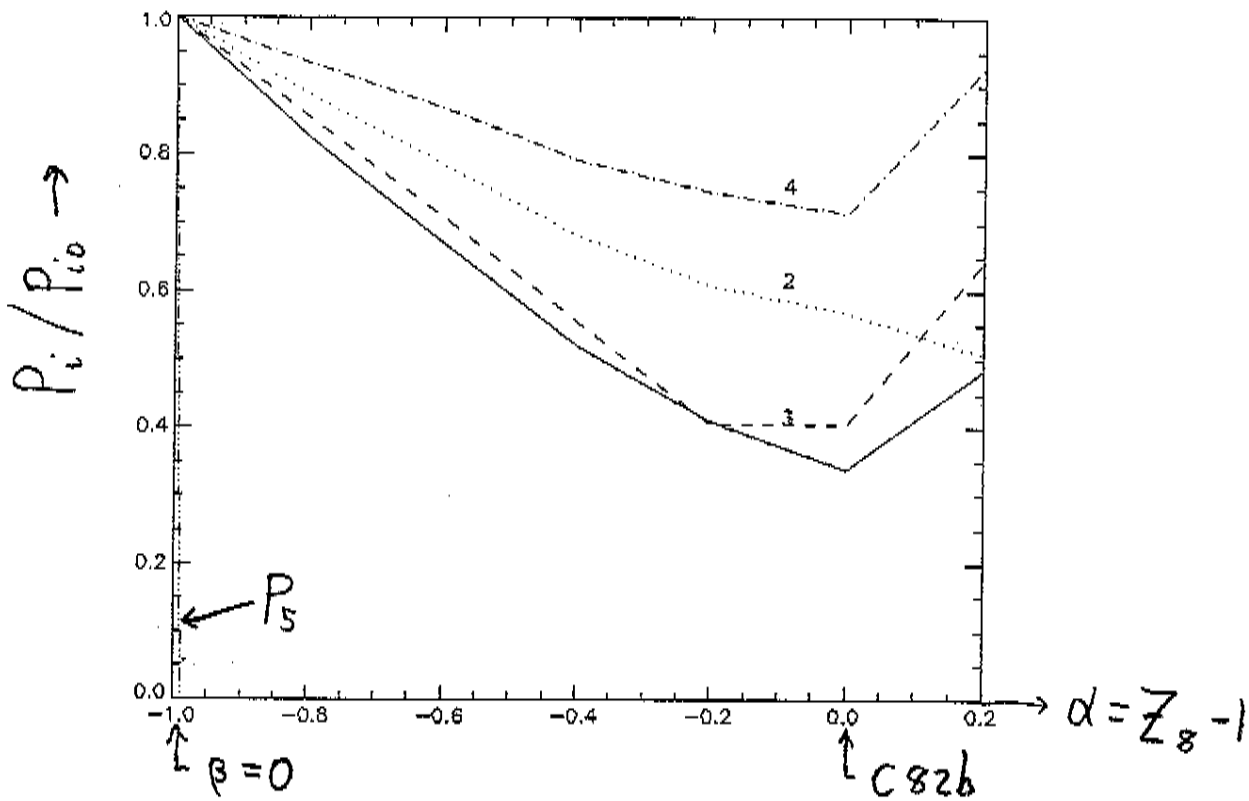
◦ Configuration c82c_6.4 : $Z_6 = 0.9$

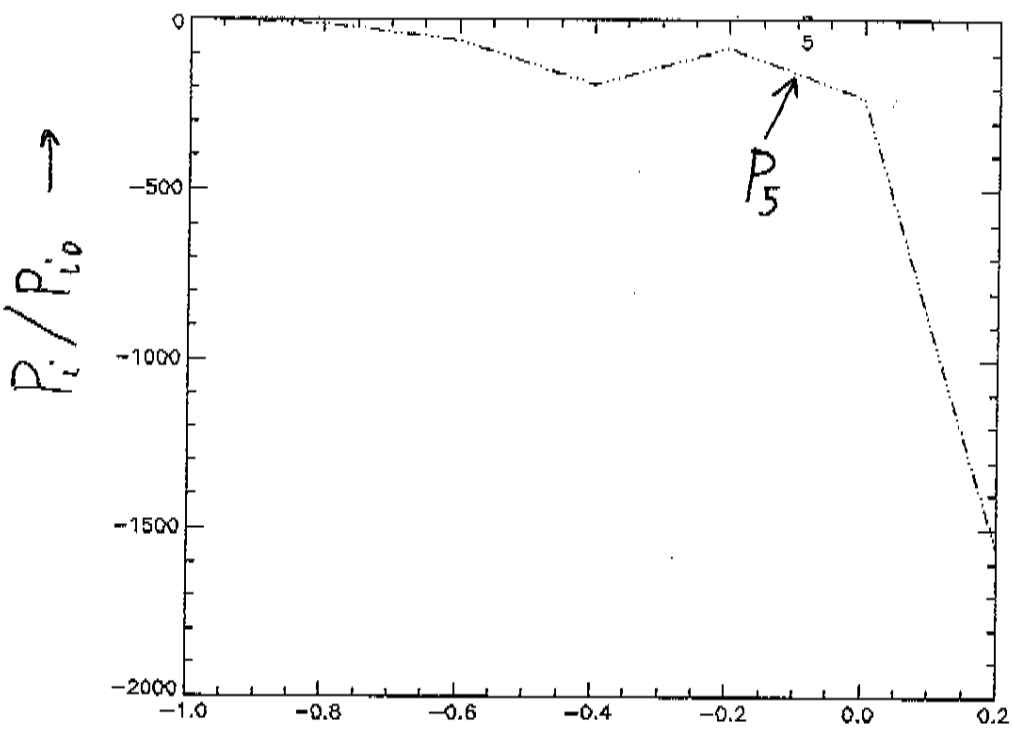




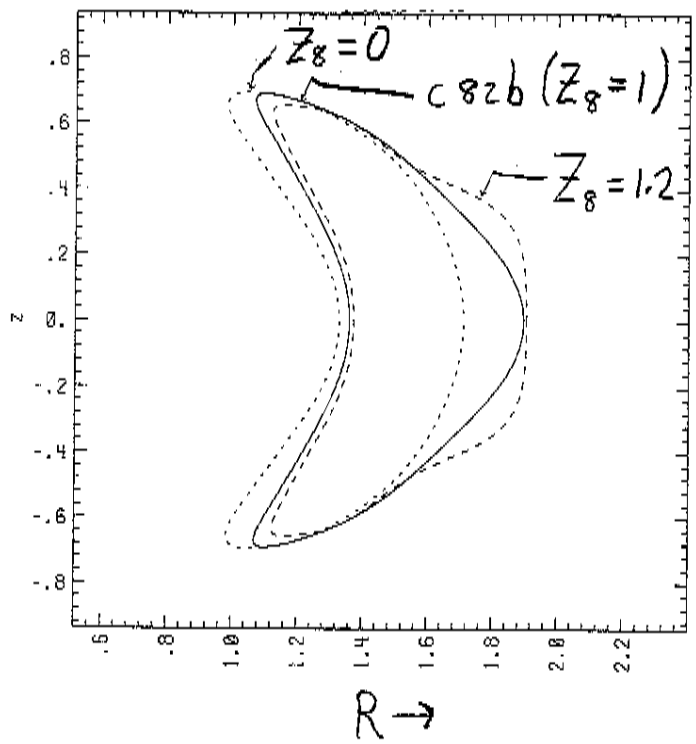
machine	P_1	P_5
c10a	1.4276E-04	-1.43303E-03
c82	1.5517E-04	-4.92465E-05
c82b	3.5605E-04	6.65416E-06
(with coec=coep=1.05):		
c82b2	3.5605E-04	-5.11848E-04
c82c_6.4	3.4273E-04	-4.25327E-05
(Brooks-Reiersen tilted-coil case121.5):		
c82BR.0	1.7708E-04	-1.61210E-03

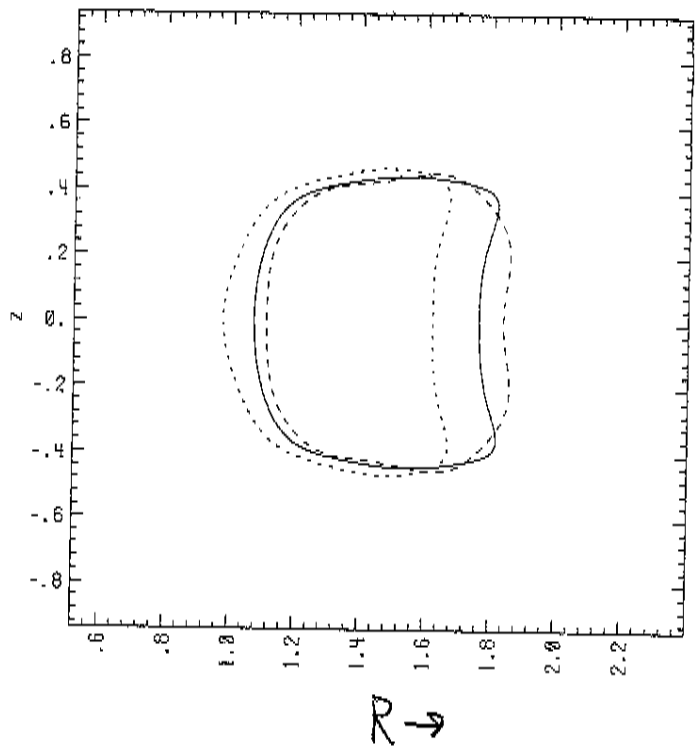
∘Preliminary test of startup:
Sweep $Z_8 \equiv \langle\beta\rangle/\langle\beta\rangle_0$:



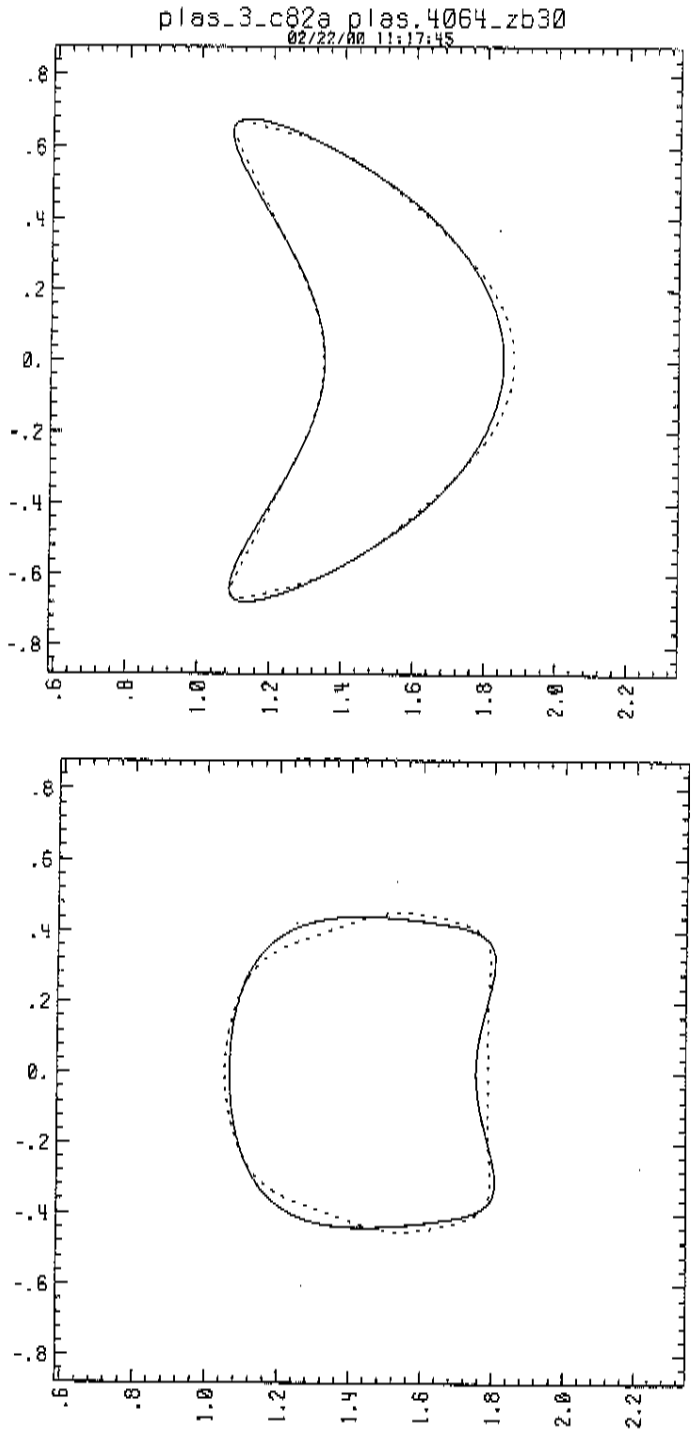


* β - sweep (cont.):





∘Next-step startup result:

Recent CUROPT runs by Brooks, Reiersen have done the 'S2' case (full current, $\langle\beta\rangle = 0$), varying the I_j to match the c82 target boundary.

·Find QA-ness better than the full $\langle\beta\rangle$ c82b.