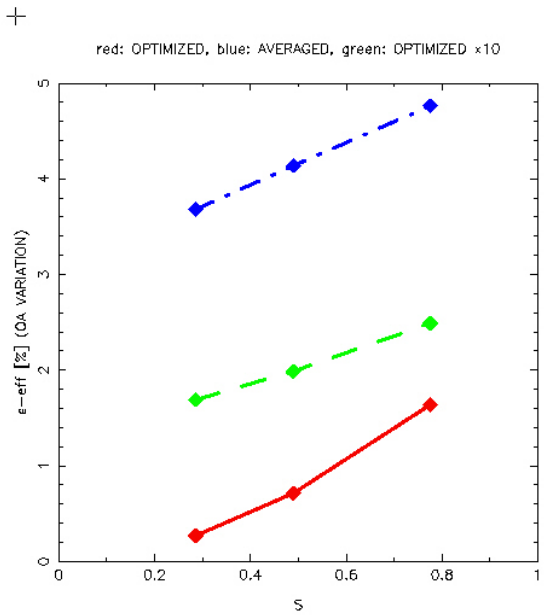
FLEXIBILITY STUDIES AND THE FIRST WALL BOUNDARY

Neil P. 4/11/02

- Almost all calculations completed (and write-up progressing well)
- Ip-beta scans: √
- Current and pressure profile variations (core and edge): √
- QA variation: √ (better set of numerical experiments than PVR!)

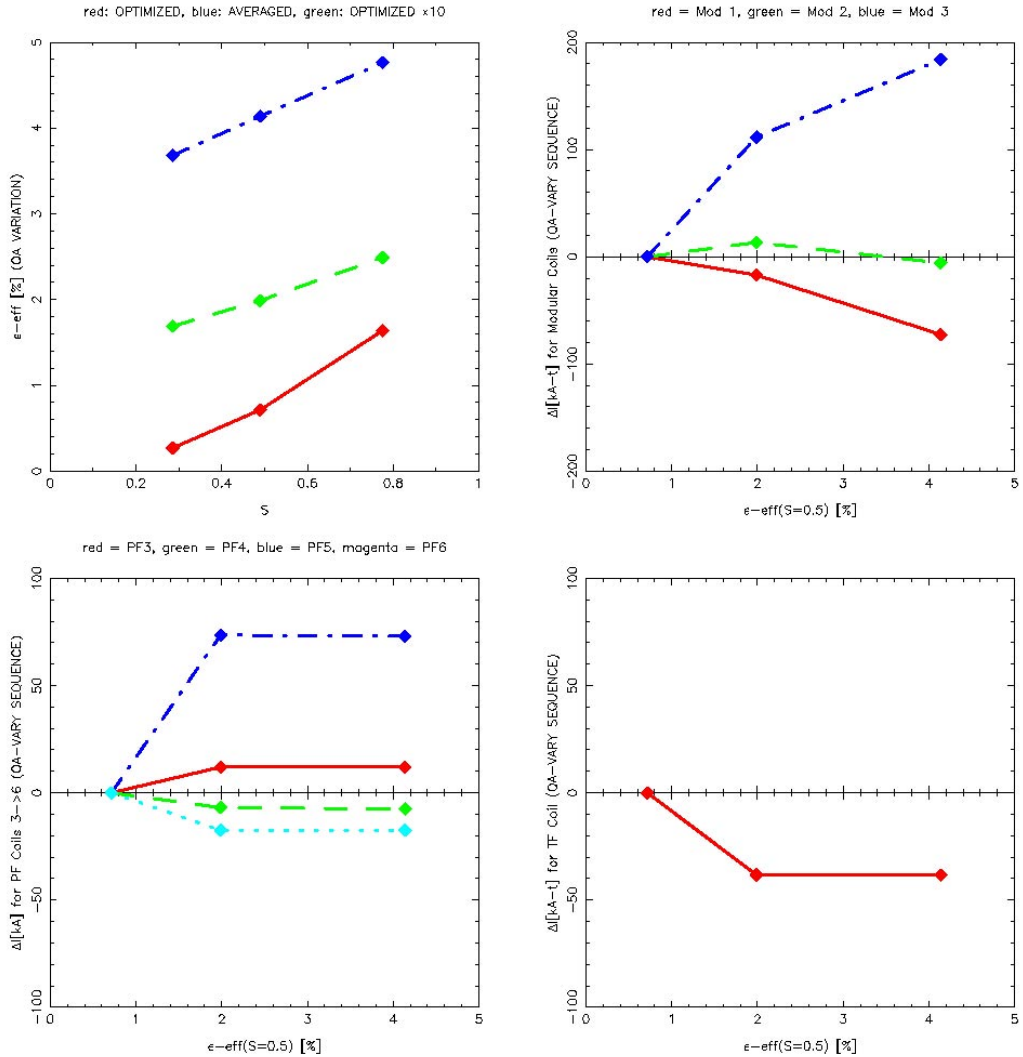


Reference config: I_p = -87.5kA, β = 2% from I_p-β scan.
=> Red (ε_{eff} = 0.5%)

Use optimizer to target 10-fold increase in ε_{eff} at s=0.5
=> Blue (ε_{eff} = 4.1%)

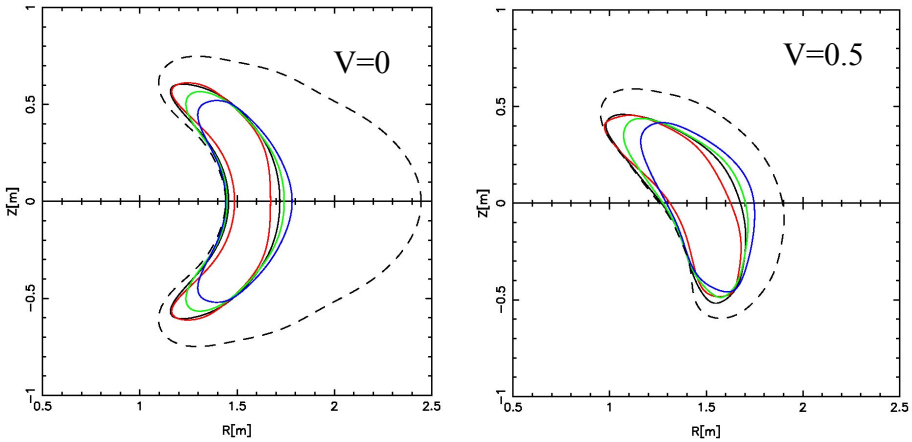
Average coil currents between Red and Blue configs
=> Green (ε_{eff} = 2.0%)

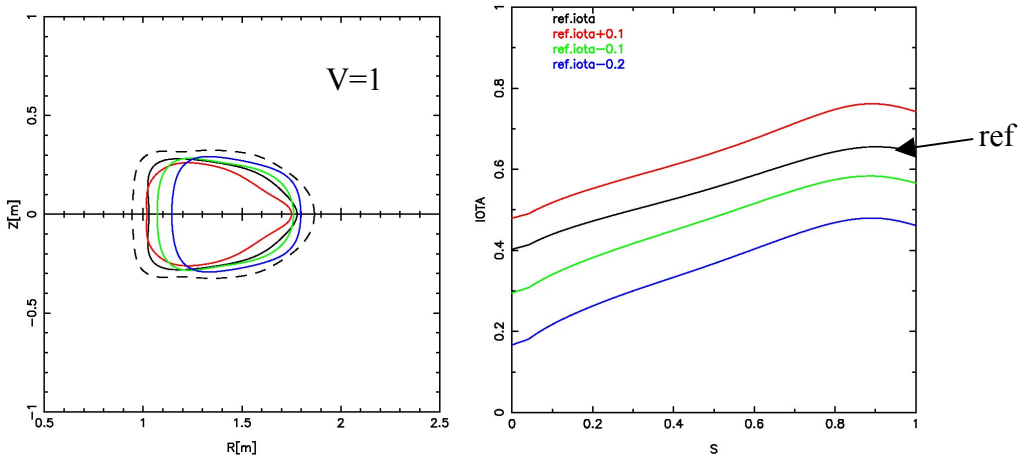
FLEXIBILITY TO VARY QA-NESS (Cont)…COIL CURRENTS



BUT struggling somewhat with iota flexibility, especially inducing negative shear

(1) CONSTANT SHEAR OK:





Δι(s) = +0.1, -0.2 achieved

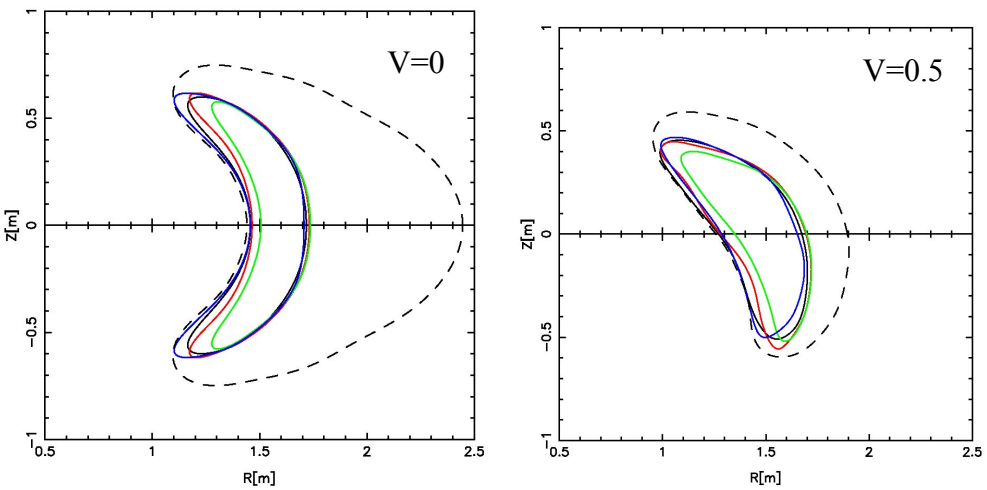
Limits imposed by plasma shape:

Note square peg in round box issue for decreased ι.

Δι(s)	ΔI_{M1} [kA-turns]	ΔI_{M2} [kA-turns]	ΔI_{M3} [kA-turns]	ΔI_{TF} [kA-turns]	ΔI_{PF3} [kA-turns]	ΔI_{PF4} [kA-turns]	ΔI_{PF5} [kA-turns]	ΔI_{PF6} [kA-turns]
+0.1	+65.	+60.	+75.	-67.	0.	-1021.	+113.	+1.
-0.1	-78.	-61.	-66.	+73.	0.	-393.	-33.	+0.
-0.2	-181.	-157.	-161.	+167.	-1684.	-947.	-40.	+7.

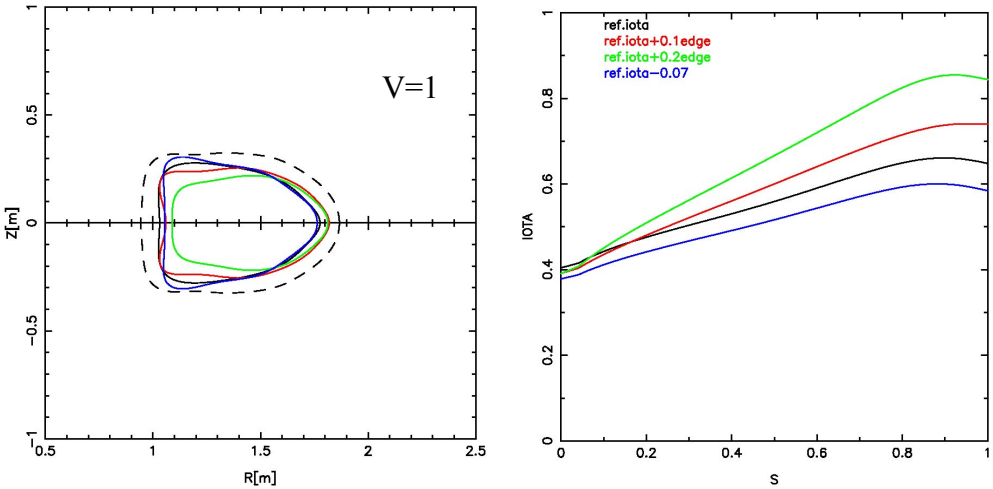
Table 9-10. Coil current variation for raising/lowering ι(s) at constant shear (see Figure 9-13)
Current differences are from the reference S3 state

(2) INDUCING SHEAR (POSITIVE AND NEGATIVE):



$\Delta\iota(1)$ = +0.2 achieved, but for decreasing shear, only $\Delta\iota(1)$ = -0.07.

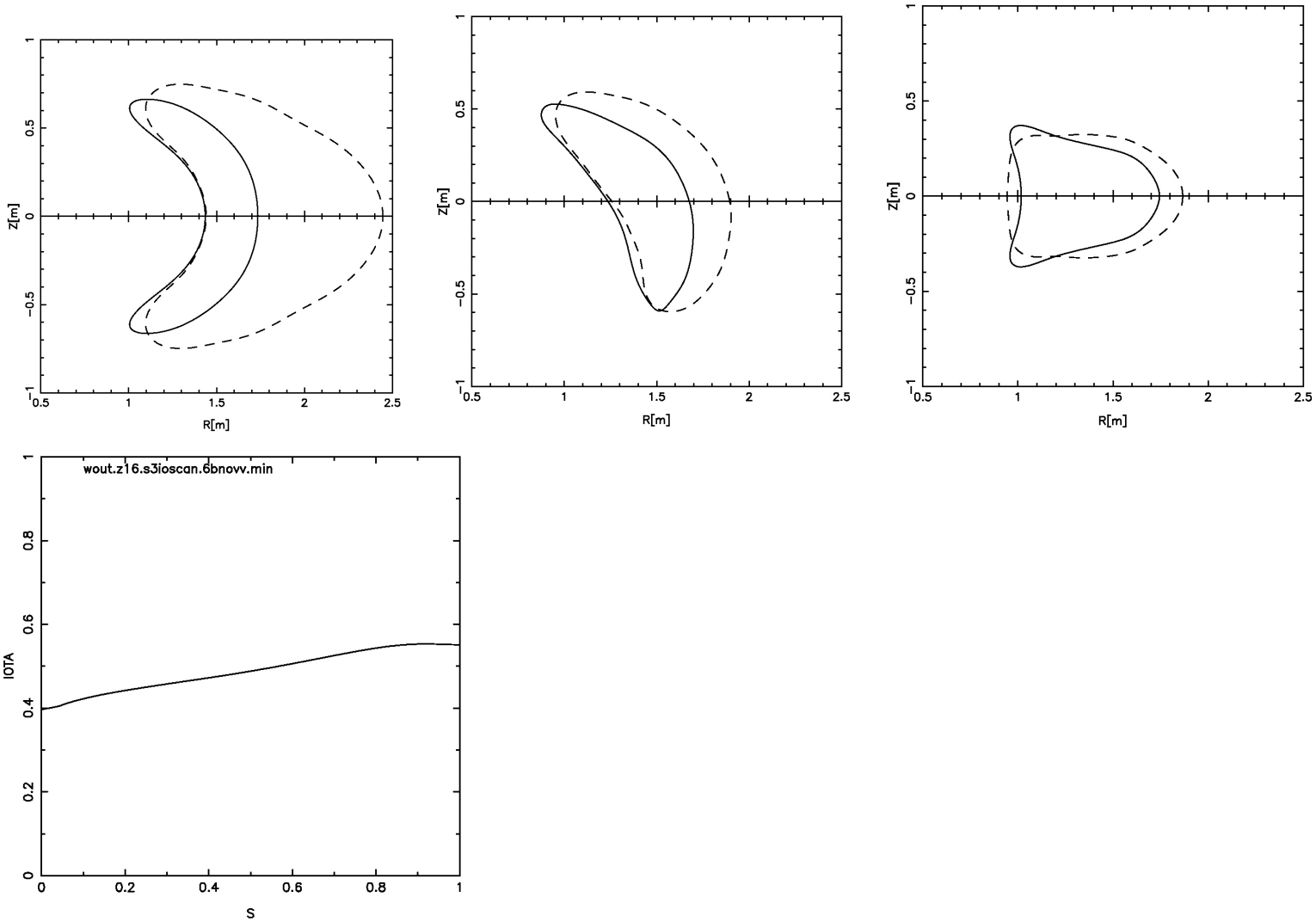
Note interference of First wall boundary with plasma



$\Delta\iota(1)$	ΔI_{M1} [kA-turns]	ΔI_{M2} [kA-turns]	ΔI_{M3} [kA-turns]	ΔI_{TF} [kA-turns]	ΔI_{PF3} [kA-turns]	ΔI_{PF4} [kA-turns]	ΔI_{PF5} [kA-turns]	ΔI_{PF6} [kA-turns]
+0.1	+40.	+20.	-13.	-19.	0.	-617.	-35.	+0.
+0.2	+64.	+1.	+17.	-29.	0.	-1219.	-94.	-2.
-0.07	-218.	+309.	-139.	+15.	0.	-1161.	+68.	+0.

Table 9-11. Coil currents for increasing/decreasing shear (see Figure 9-14)

CAN ACHIEVE $\Delta\iota(1) = -0.1$ IF IGNORE FIRST WALL BOUNDARY CONSTRAINT


Z[m]
R[m]
Z[m]
R[m]
Z[m]
R[m]
wout.z16.s3ioscan.6bnovv.min
IOTA
S

$\Delta\iota(1)$	ΔI_{M1} [kA-turns]	ΔI_{M2} [kA-turns]	ΔI_{M3} [kA-turns]	ΔI_{TF} [kA-turns]	ΔI_{PF3} [kA-turns]	ΔI_{PF4} [kA-turns]	ΔI_{PF5} [kA-turns]	ΔI_{PF6} [kA-turns]
+0.1	+40.	+20.	-13.	-19.	0.	-617.	-35.	+0.
+0.2	+64.	+1.	+17.	-29.	0.	-1219.	-94.	-2.
-0.07	-218.	+309.	-139.	+15.	0.	-1161.	+68.	+0.
-0.10	**-143.**	**+101.**	**+44.**	**0.**	**0.**	**+65.**	**+18.**	**-1.**

Last row gives coil current changes when ignore first wall boundary.

SUMMARY

- **We do not appear to have as much iota flexibility as in previous design.**

- **This doesn't appear to be due to the coils except in so far as they define the first wall boundary.**

- **Mike Z has been looking at repositioning the coils on the same winding surface so as to form a plasma better centered within the first wall boundary that should give us some more flexibility and be better suited to the divertor design P.M.)**