NCSX Modular Option Developments

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- Recent CoilOpt improvements
- Modular coil solutions for LI383
- Initial results for HI3351F
- Summary

Recent CoilOpt Developments

- Additional flexibility in winding law (windback)

  $\phi = \Sigma a_k \cos(2\pi ku) + b_k \sin(2\pi ku)$

  $u = \Sigma c_j \sin(2\pi ju')$

- Target coil radius of curvature (engineering difficulty)

  $\rho = 1/\kappa$

  $\kappa = \left| d\mathbf{r}/du \times d^2\mathbf{r}/du^2 \right| / \left| d\mathbf{r}/du \right|^3$

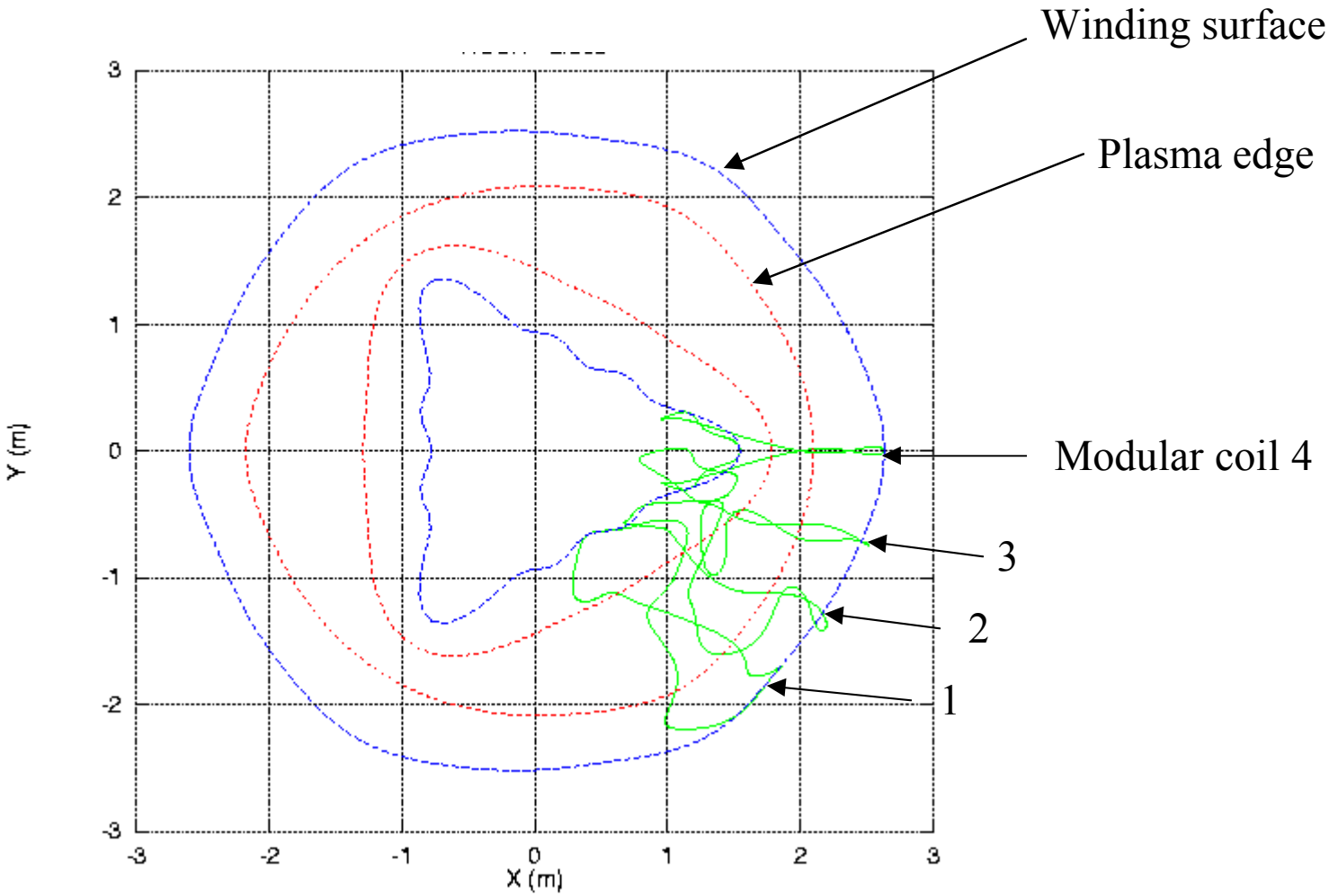
- Approximate maximum field at coils ($\mathbf{B}_{max}/\mathbf{B}_0$)

CoilOpt Targets for NCSX Modular Coils

- Normal component of **B** at plasma edge - δB_{rms}
- Min. coil-coil separation - $\Delta_{cc,min}$
- Min. coil-plasma separation - $\Delta_{cp,min}$
- Min. coil radius of curvature - ρ_{min}
- Coil length – L_c

Modular Coils for LI383

Solution 0907a1

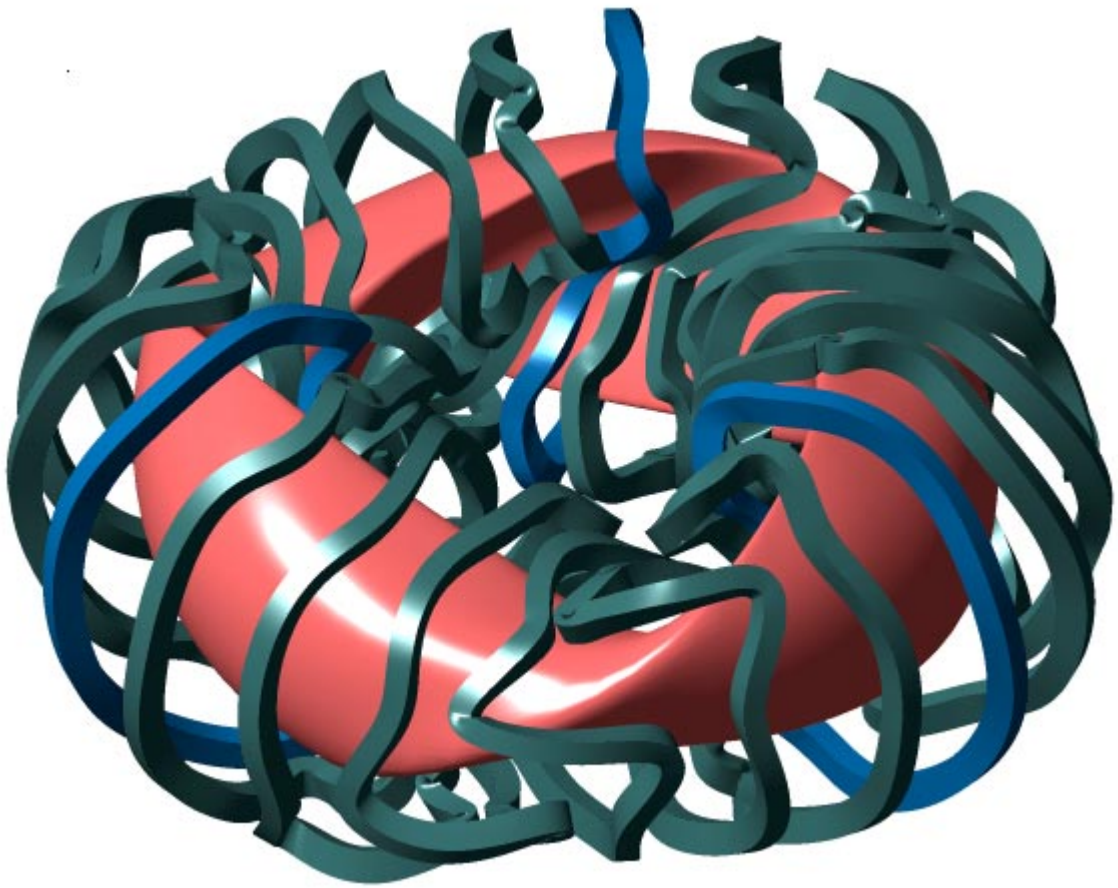


Modular Solutions for LI383

ID#	δB_{avg} (%)	δB_{max} (%)	$\Delta_{cc,min}$ (cm)	$\Delta_{cp,min}$ (cm)	ρ_{min} (cm)	$L_{c,avg}$ (m)
0705a1	0.73	3.17	15.0	21.7	4.1	7.23
0811a1	0.83	3.45	13.6	21.0	9.2	7.20
0907a1	0.57	2.67	13.6	23.2	11.1	7.36

Modular Coils for LI383

Solution 0811a1

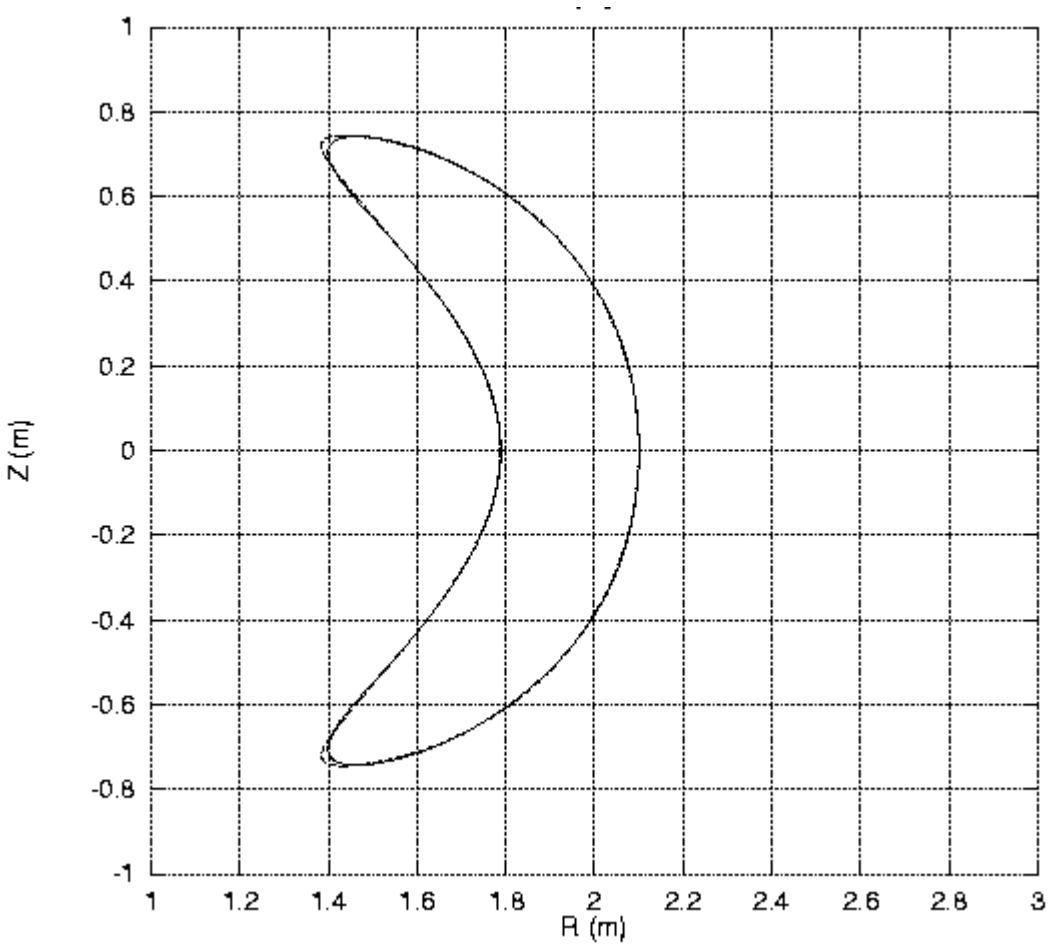


D. Williamson

Free-boundary Reconstruction of LI383

Modular Coil Solution 0907a1

v = 0

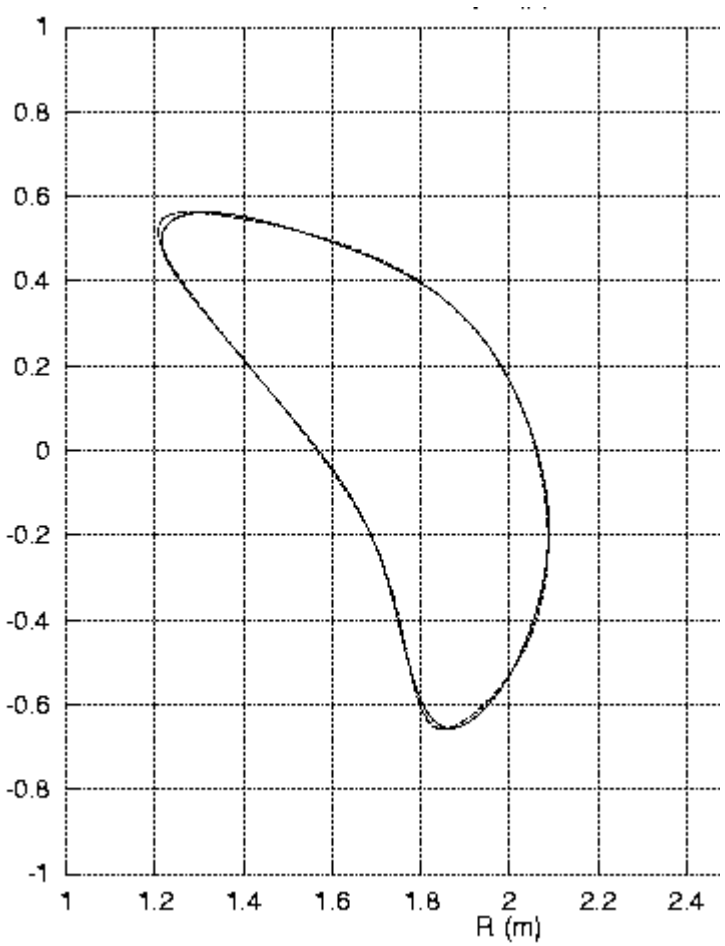


	Free	(Fixed)
A =	4.37	(4.37)
R =	1.73m	(1.73m)
ι(0) =	0.40	(0.39)
ι(1) =	0.65	(0.65)
β =	4.23%	(4.25%)

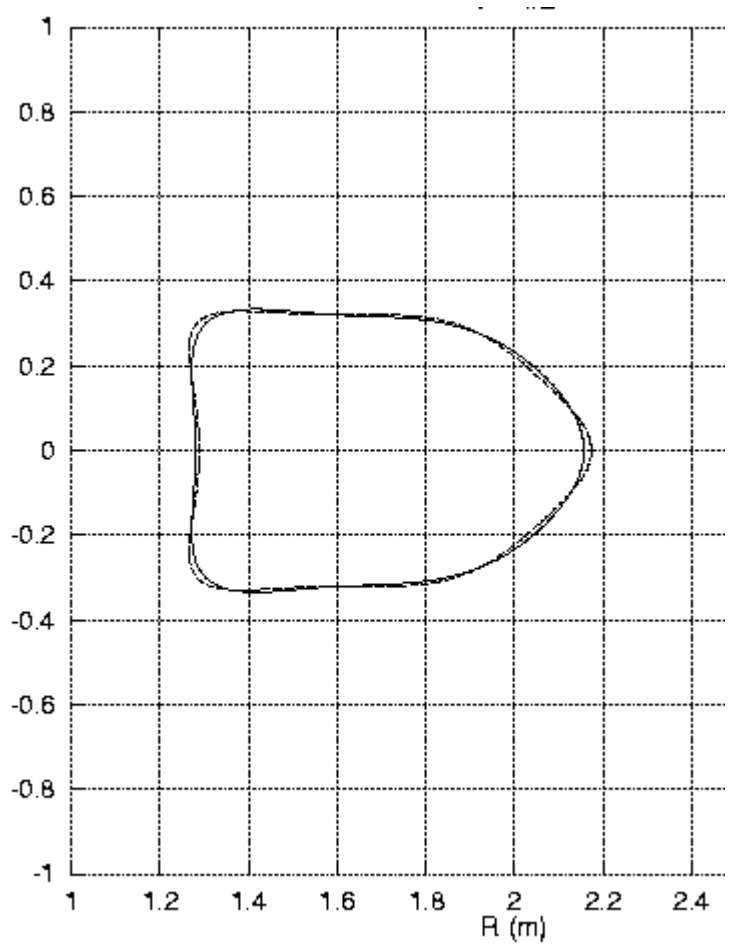
Free-boundary Reconstruction of LI383

Modular Coil Solution 0907a1

v = 1/4



v = 1/2



Modular Solution for HI3351F
(Compared with LI383)

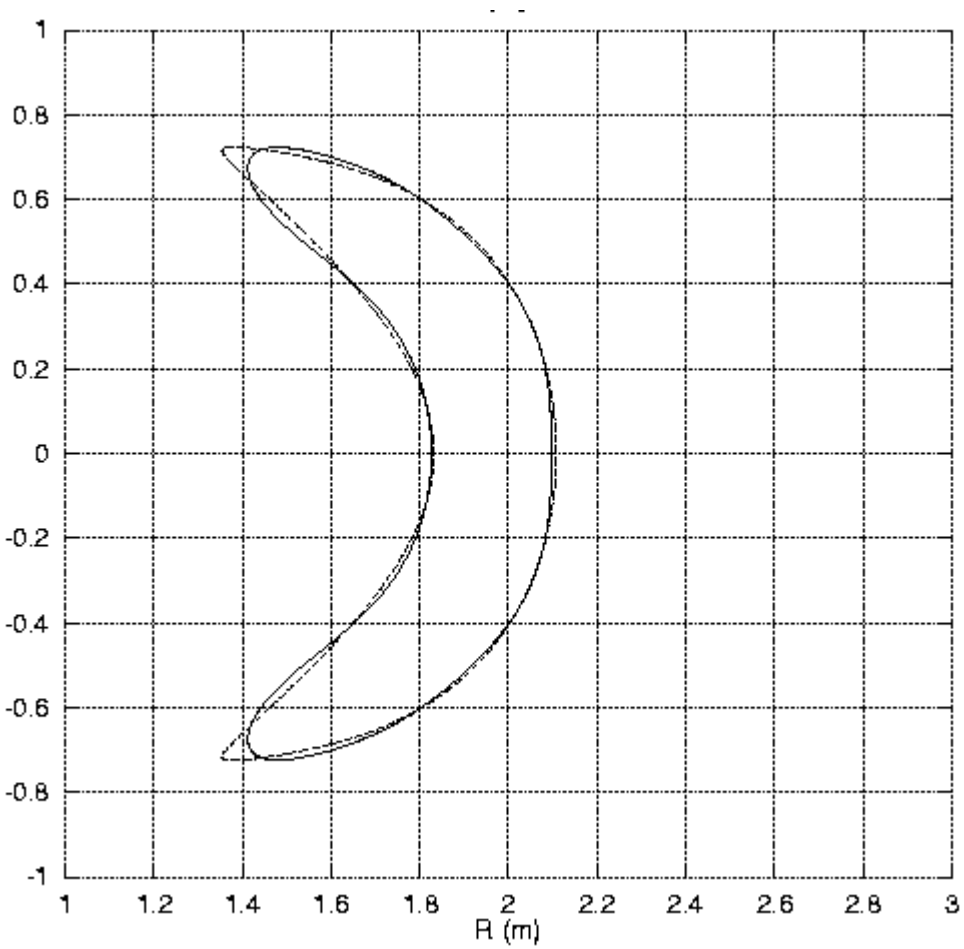
Coil number

ID#	δB_{avg} (%)	δB_{max} (%)	$\Delta_{cc,min}$ (cm)	$\Delta_{cp,min}$ (cm)	ρ_{min} (cm)	$L_{c,avg}$ (m)	B_{max}/B_0
LI383 0907a1	0.57	2.67	13.6 (1-2)	23.2	11.1 (1)	7.36	1.81 (2)
HI3351F 0925a2	0.87	5.21	13.5 (1-1)	22.3	11.2 (1)	7.59	1.88 (4)

Free-boundary Reconstruction of HI3351F

Modular Coil Solution 0925a2

v = 0

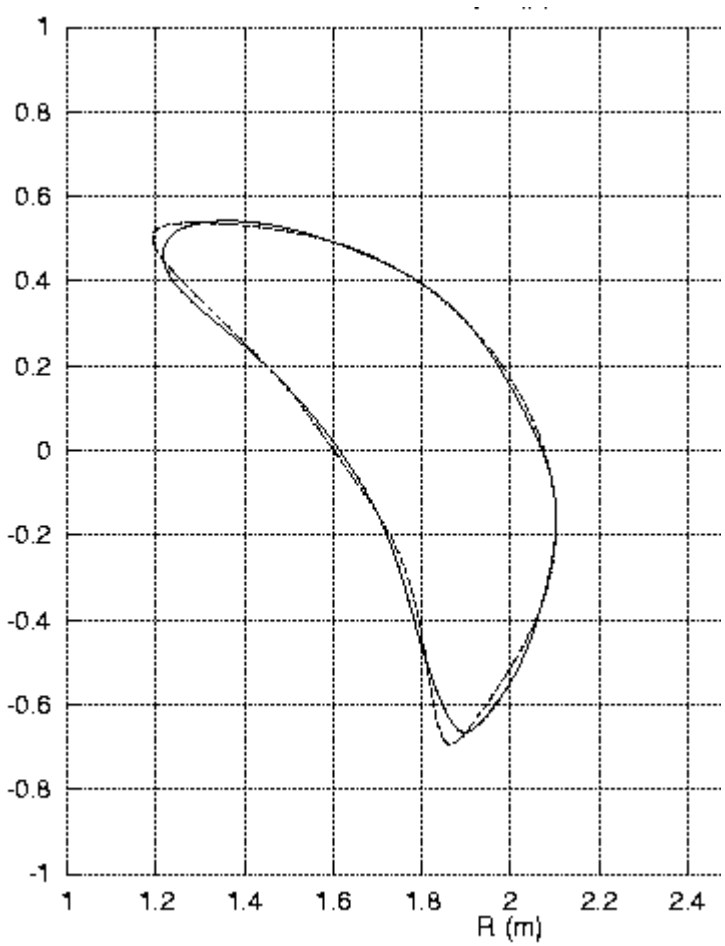


	Free	(Fixed)
A =	4.56	(4.57)
R =	1.75m	(1.75m)
$\iota(0)$ =	0.502	(0.52)
$\iota(1)$ =	0.74	(0.74)
β =	3.99%	(4.00%)

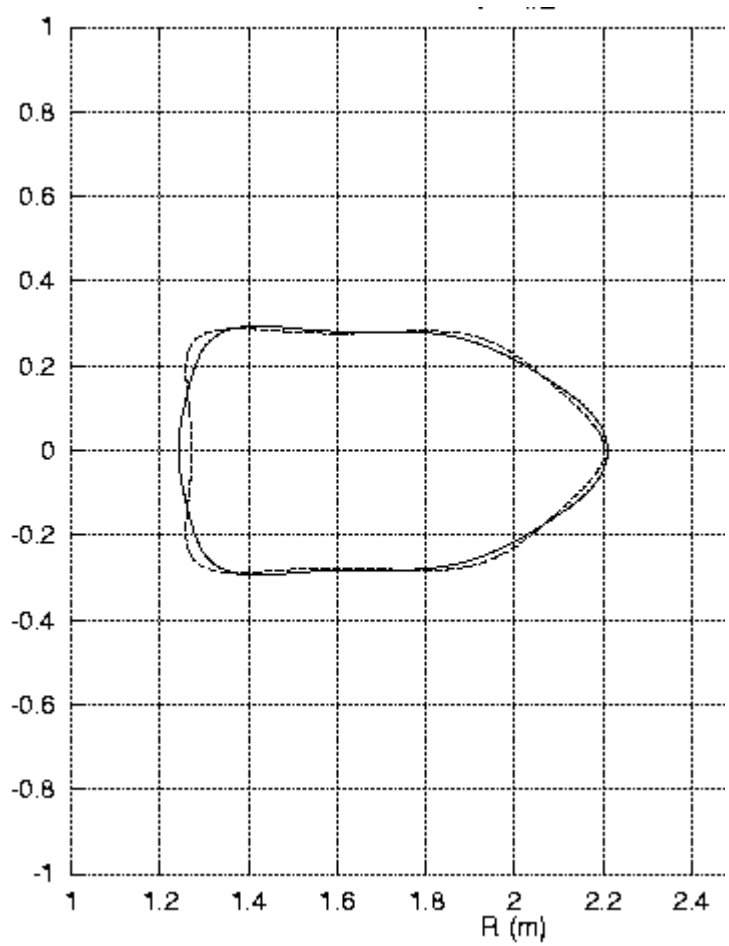
Free-boundary Reconstruction of HI3351F

Modular Coil Solution 0925a2

v = 1/4



v = 1/2



Summary

- Improved radius of curvature for modular coil solutions
- Modulars for LI383 show improved engineering parameters, reconstruct target configuration
- Initial results for HI3351F indicate slightly higher field errors for comparable measures of engineering difficulty