Modular Coils for 2-fp QOS

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- Configuration: A2.5_Jopt.b.015
  - A = 2.5
  - β = 1.5%
  - Iota = 0.28 – 0.40 (fixed boundary)
- Modular solutions for 11 and 12 coils/field period
- Free-boundary reconstructions

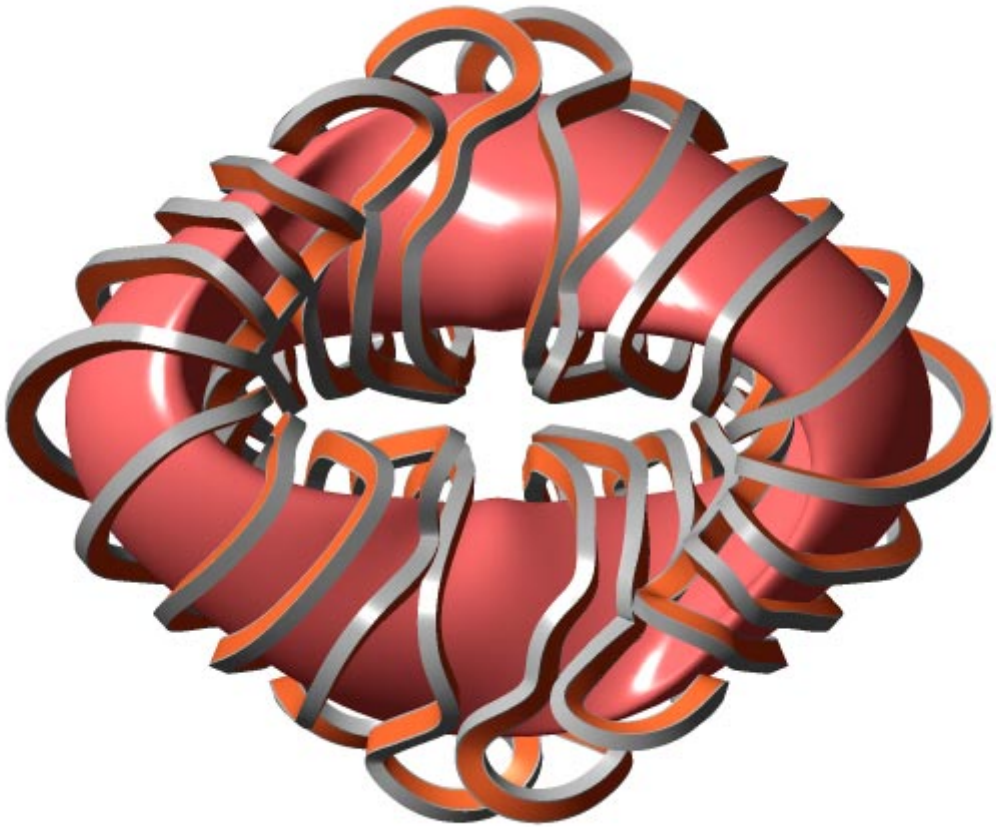
CoilOpt Targets for QOS Modular Coils

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

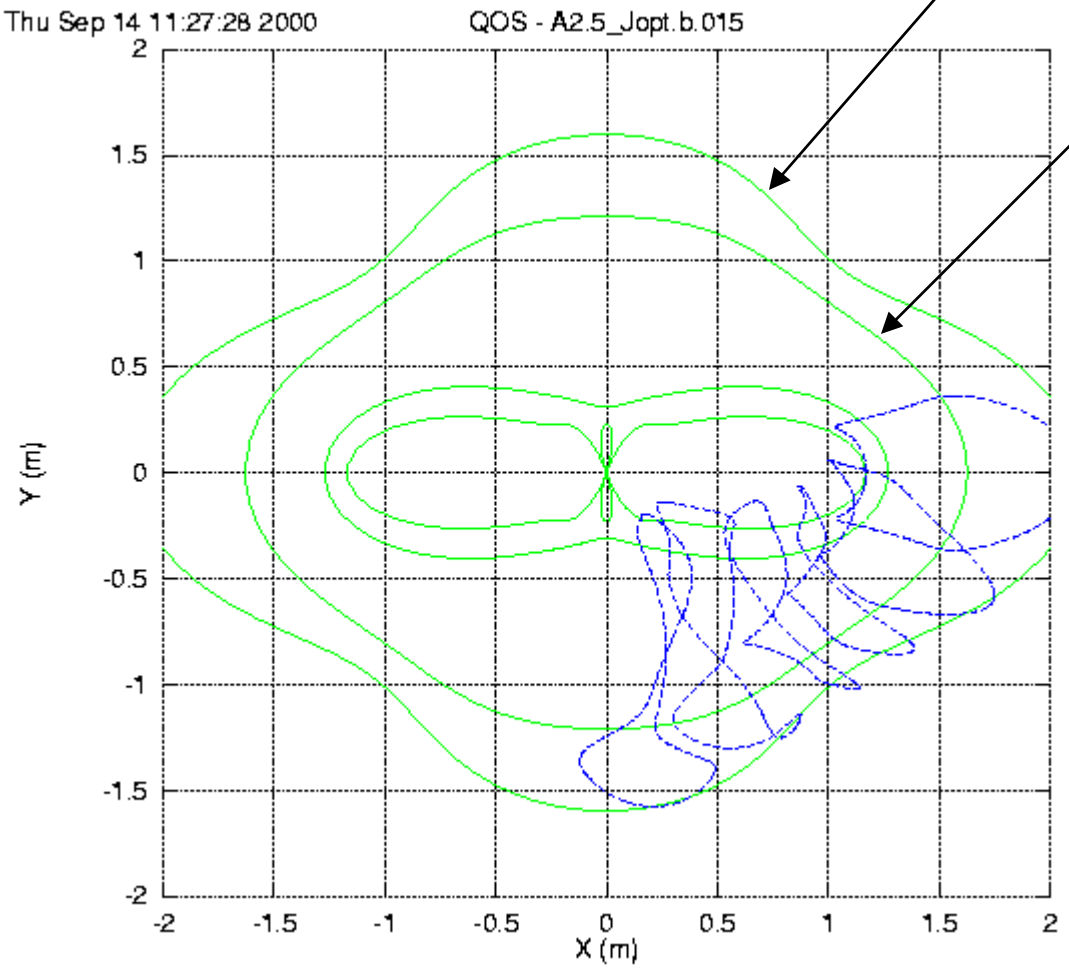
Modular Coil Results for 2-fp QOS

ID#	Nc	δB_{avg} (%)	δB_{max} (%)	$\Delta_{cc,min}$ (cm)	$\Delta_{cp,min}$ (cm)	ρ_{min} (cm)	R_{max} (m)
0812a4	11	1.9	14.3	7.7	9.1	6.1	2.2
0831b3	12	3.1	18.1	7.3	8.9	5.7	1.95
0829b1	11	1.9	12.6	7.4	9.1	6.6	2.0

QOS Modular Coils – solution 0829b1



Modular Coils – solution 0812a4



11 coils per field period

Coil 6 length:

$w_6 = 0$

$L_6 = 4.85$ m

$R_{6,max} = 2.2$ m

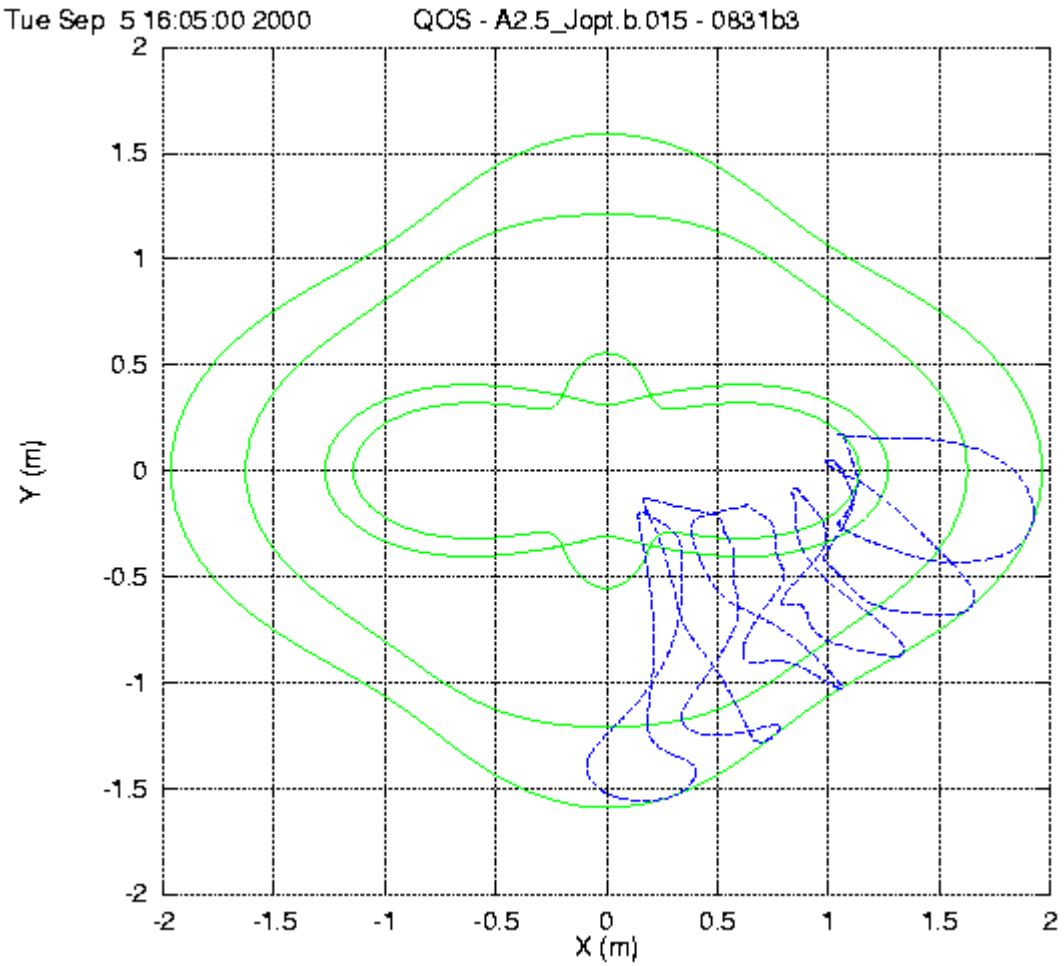
$\delta B_{avg} = 1.9\%$, $\delta B_{max} = 14.3\%$

$\Delta_{cc,min} = 7.7$ cm

$\Delta_{cp,min} = 9.1$ cm

$\rho_{min} = 6.1$ cm

Modular Coils – solution 0831b3



12 coils per field period

Coil 6 length target:

$w_6 = 4.0$

$L_6(\text{tgt}) = 4.0$ m

$L_6 = 4.01$ m

$\delta B_{avg} = 3.1\%$, $\delta B_{max} = 18.1\%$

$\Delta_{cc,min} = 7.3$ cm

$\Delta_{cp,min} = 8.9$ cm

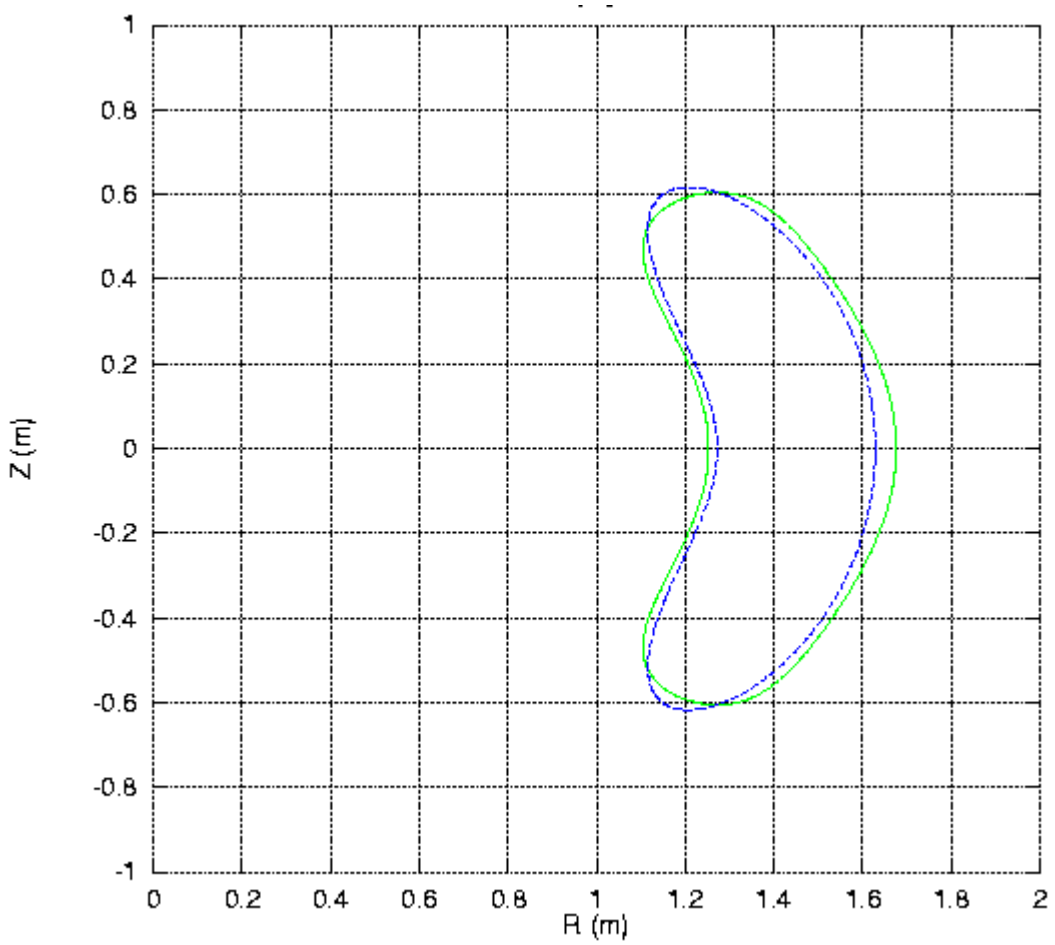
$\rho_{min} = 5.7$ cm

$I_i = 134$kA, i=1,…,5

$I_6 = 67$kA

Free-boundary reconstruction – v = 0

Modular coil set 0831b3



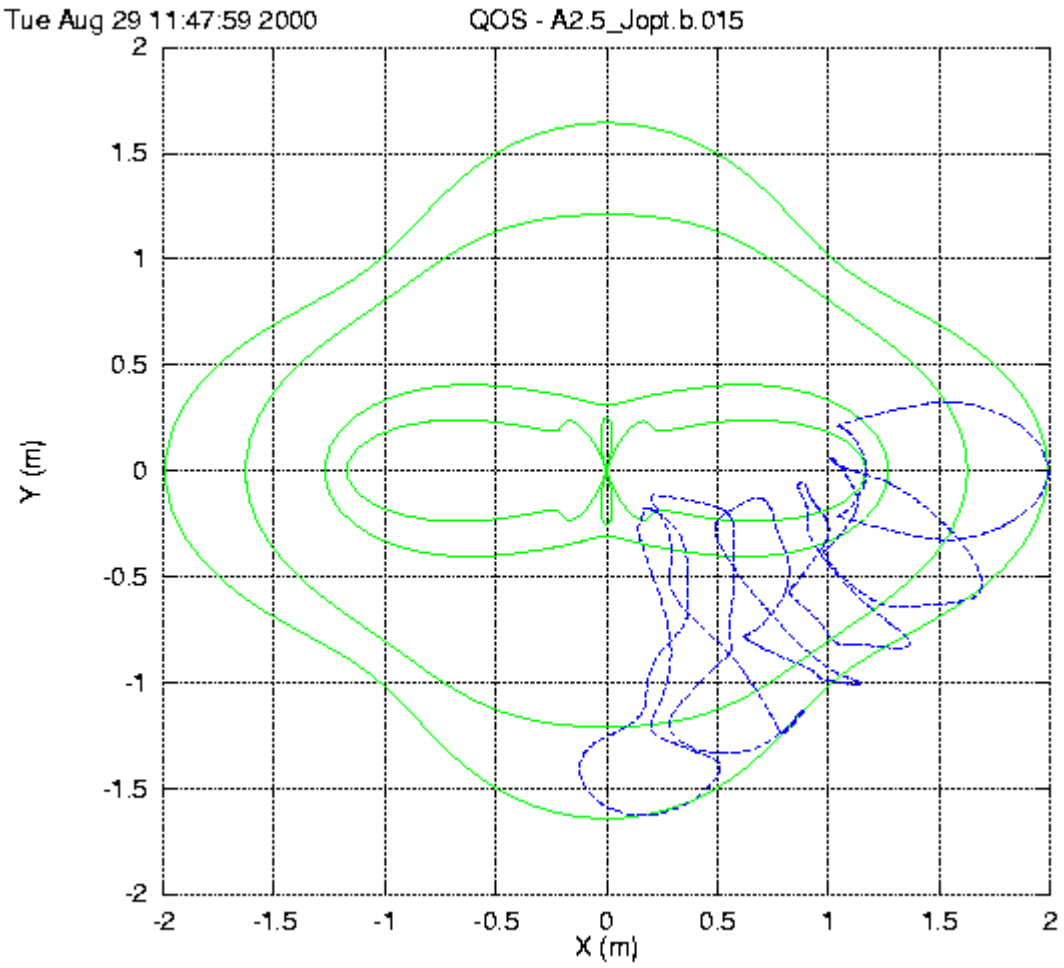
A = 2.57

β = 1.53%

Iota(0) = .276

Iota(1) = .377

Modular Coils – solution 0829b1



11 coils per field period

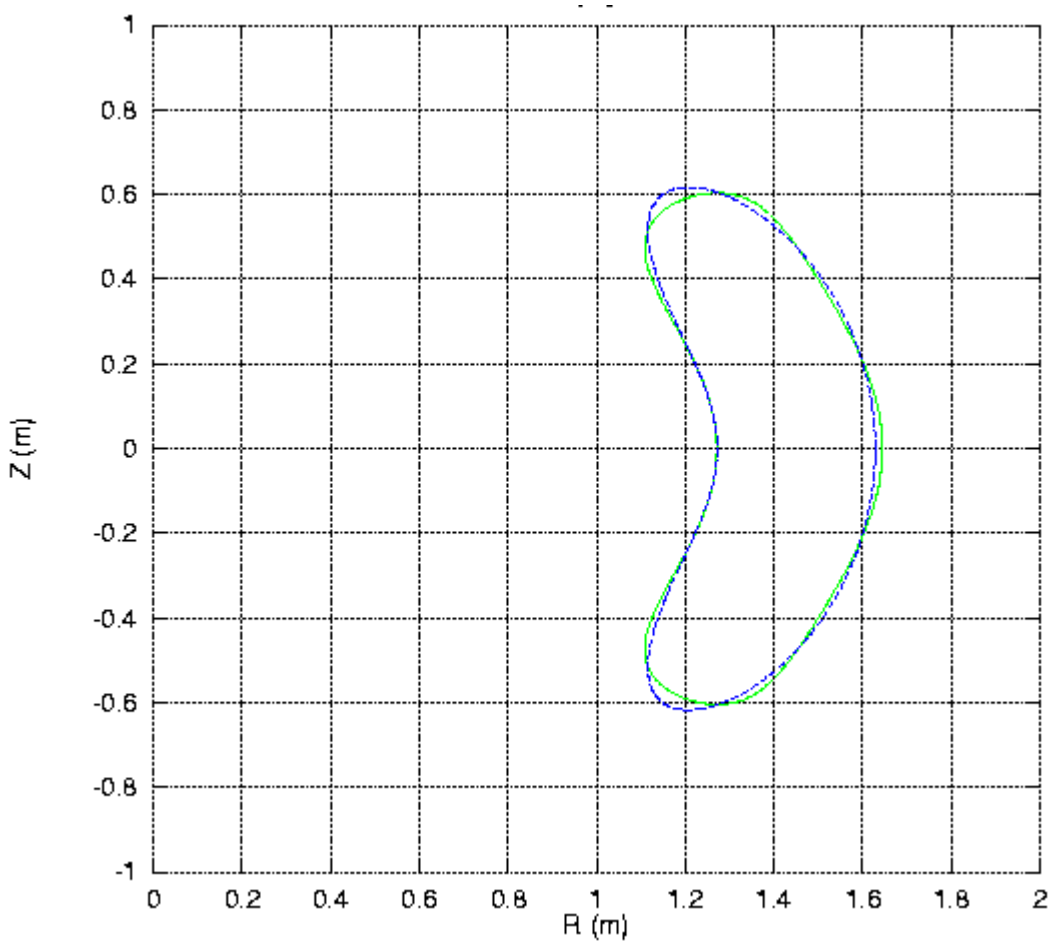
Coil 6 length target:
$w_6 = 1.0$
$L_6(\text{tgt}) = 4.2$ m
$L_6 = 4.29$ m

$\delta B_{avg} = 1.9\%$, $\delta B_{max} = 12.6\%$
$\Delta_{cc,min} = 7.4$ cm
$\Delta_{cp,min} = 9.1$ cm
$\rho_{min} = 6.6$ cm

Free-boundary reconstruction

Modular coil set 0829b1

v = 0



$p = p_0(1-s)^2$

A = 2.51

β= 1.52%

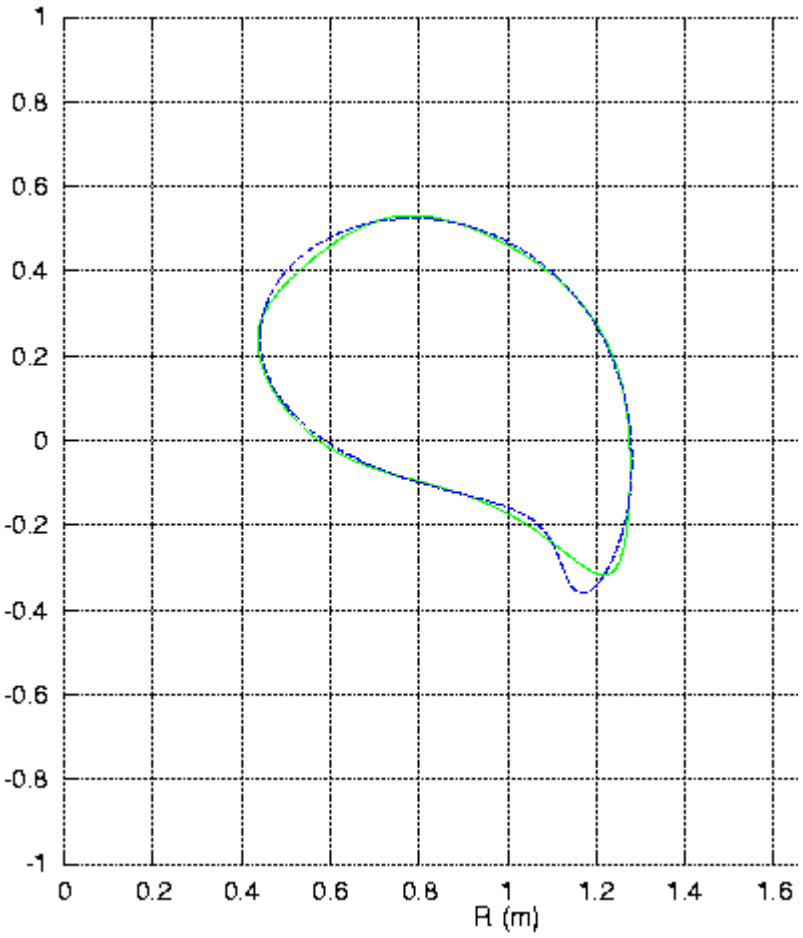
Iota(0) = .276

Iota(1) = .382

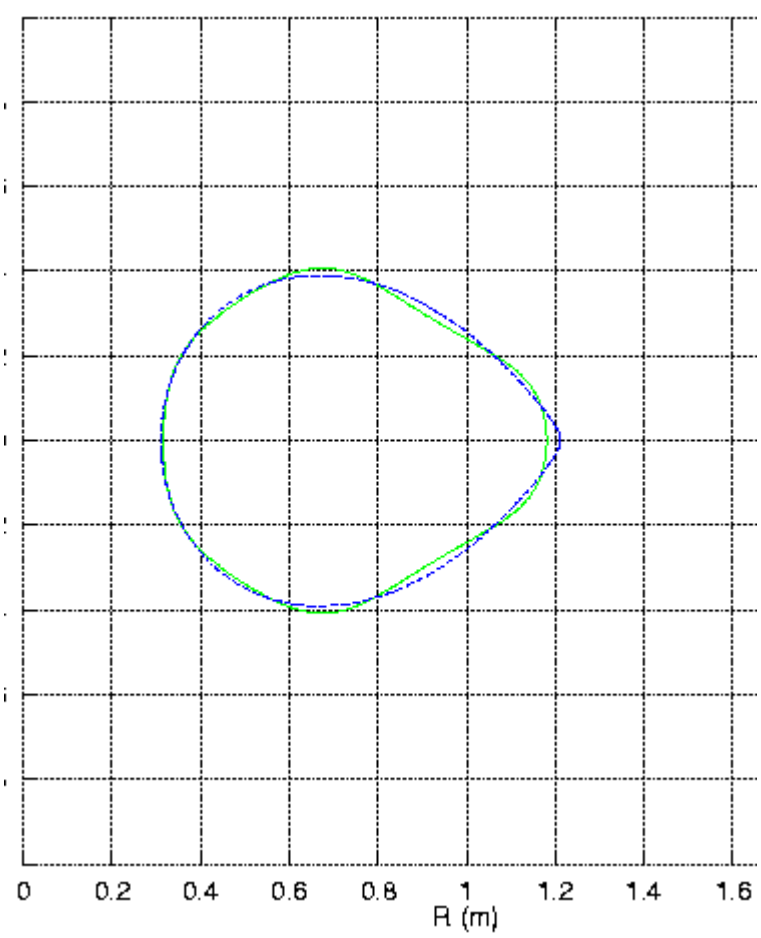
Free-boundary reconstruction

Modular coil set 0829b1

v = 1/4



v = 1/2



Summary

- Solution 0829b1 reconstructs well with $\delta B_{avg} = 1.9\%$
- Free-boundary solution preserves transport properties (Spong)
- TF, OH will require innovative engineering (Nelson)