Coil Configuration Status
C82 Plasma on Improved Surface

Stellarator Workshop Meeting

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Art Brooks, Neil Pomphrey, Prashant Valanju,

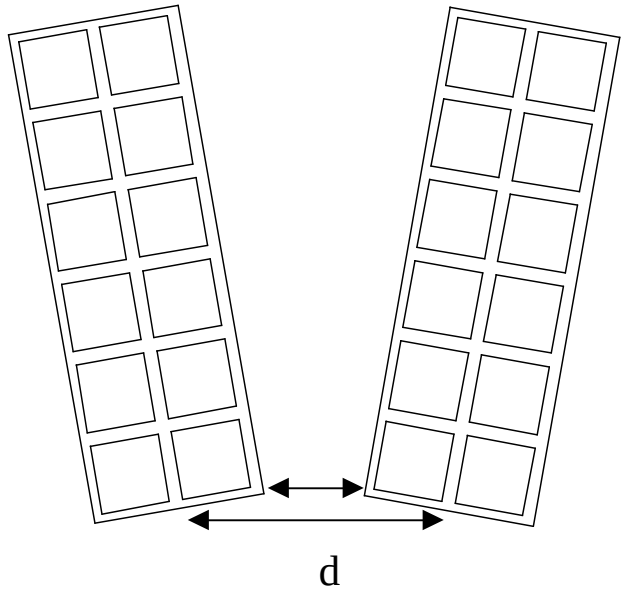
Buff Miner, Steve Hirshman

Coil Configuration Status
C82 Plasma on Improved Surface

- Coils have been cut from the reduced Jmax current sheet solutions presented by Prashant last week.
- Coils with16 uniform contours retains low current densities and leads to an acceptable current density ~ 15.0 KA/cm2 in copper at R*Btor=1.65
- Reconstruction looks good. Data has been supplied to physics for further evaluation
- Optimized coil cutting algorithm targeting Berr alone not producing acceptable coil current densities. Coils bunching up high in high current density regions
- Work to target true copper current density at coil cutting level proceeding well (Neil)

Improved calculation of filament separation and copper current density

- True filament to filament calculation, not point to point
- Done by first offsetting filaments half height of coil to account for curvature
- Engineering constraints folded in
  - 5mm min ligament root thickness
  - 1mm turn to turn Insulation
  - .5 mm clearance each side
  - Turn transisiton loss 2 of 12 turns
  - Braided Cu packing fraction (80%)



Cu Area, mm2 = 38.67*(d-10)

Coils from Last Weeks' Current Sheets

Presented by Prashant Valanju

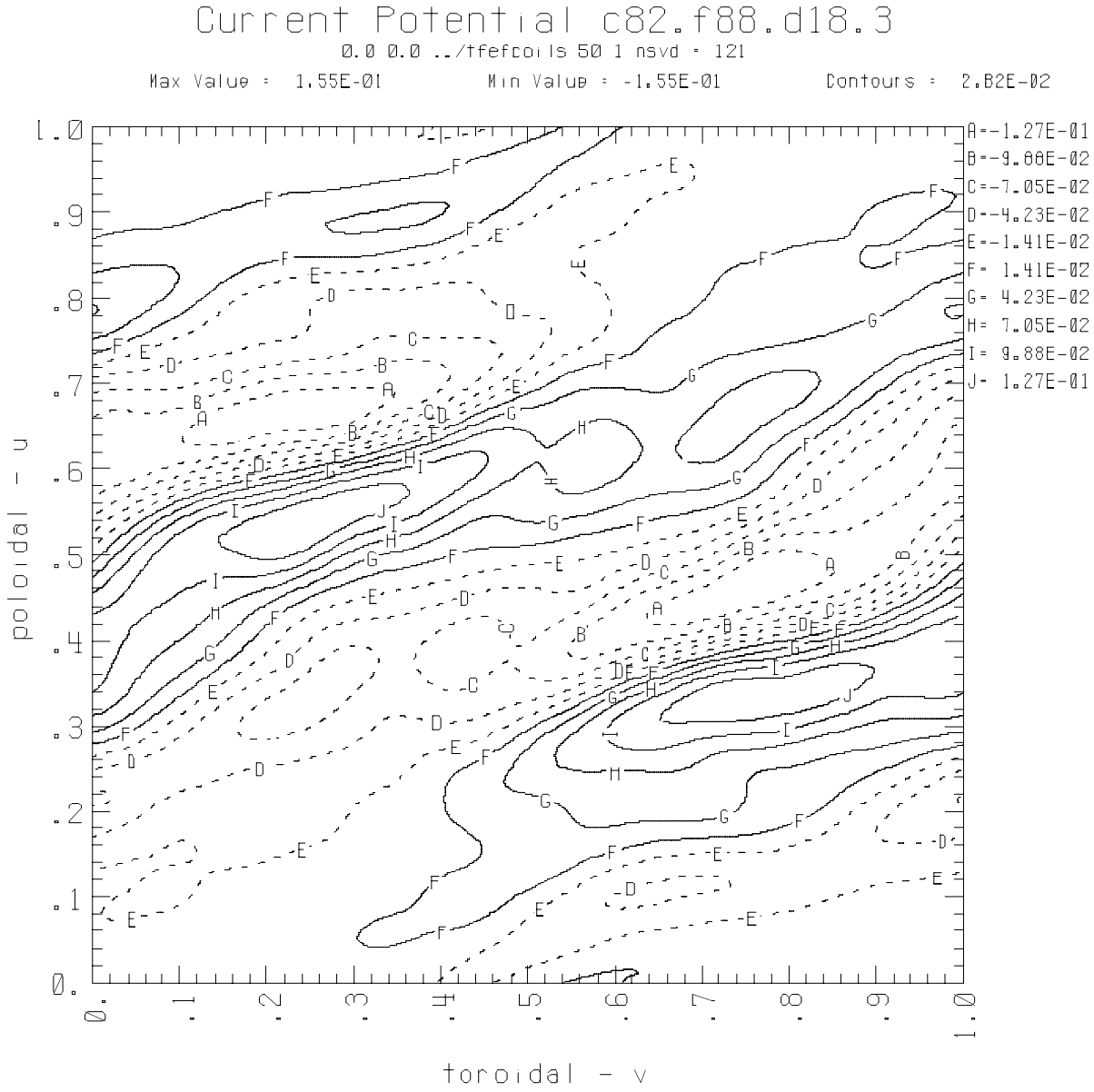
Case ID	Current Sheet			Coils				Reconstruction		
	Berr		Jmax/	Berr		Jmax/Ipol*		Plas Offsets		
	Max %	Mean %	Ipol MA/m/M	Max %	Mean %	rib t=0	thickness t=8 mm	Dmax mm	Dmean mm	chi2_free chi2_fix
d18.3.121.16	6.71	0.60	0.83	7.32	0.95	0.83	1.26	20.9	4.7	1.15
d18.3.185.10	2.00	0.26	0.92	4.61	0.62	1.03	2.25	22.9	4.5	1.05
d18.3.194.10	1.69	0.22	0.94	3.52	0.61	0.99	2.28	17.8	3.9	1.08
d18.12.201.10	2.09	0.28	0.91	3.81	0.61	1.99	3.45	23.0	4.1	1.08

*Current Sheet Equivalent, Not True Copper Current Density

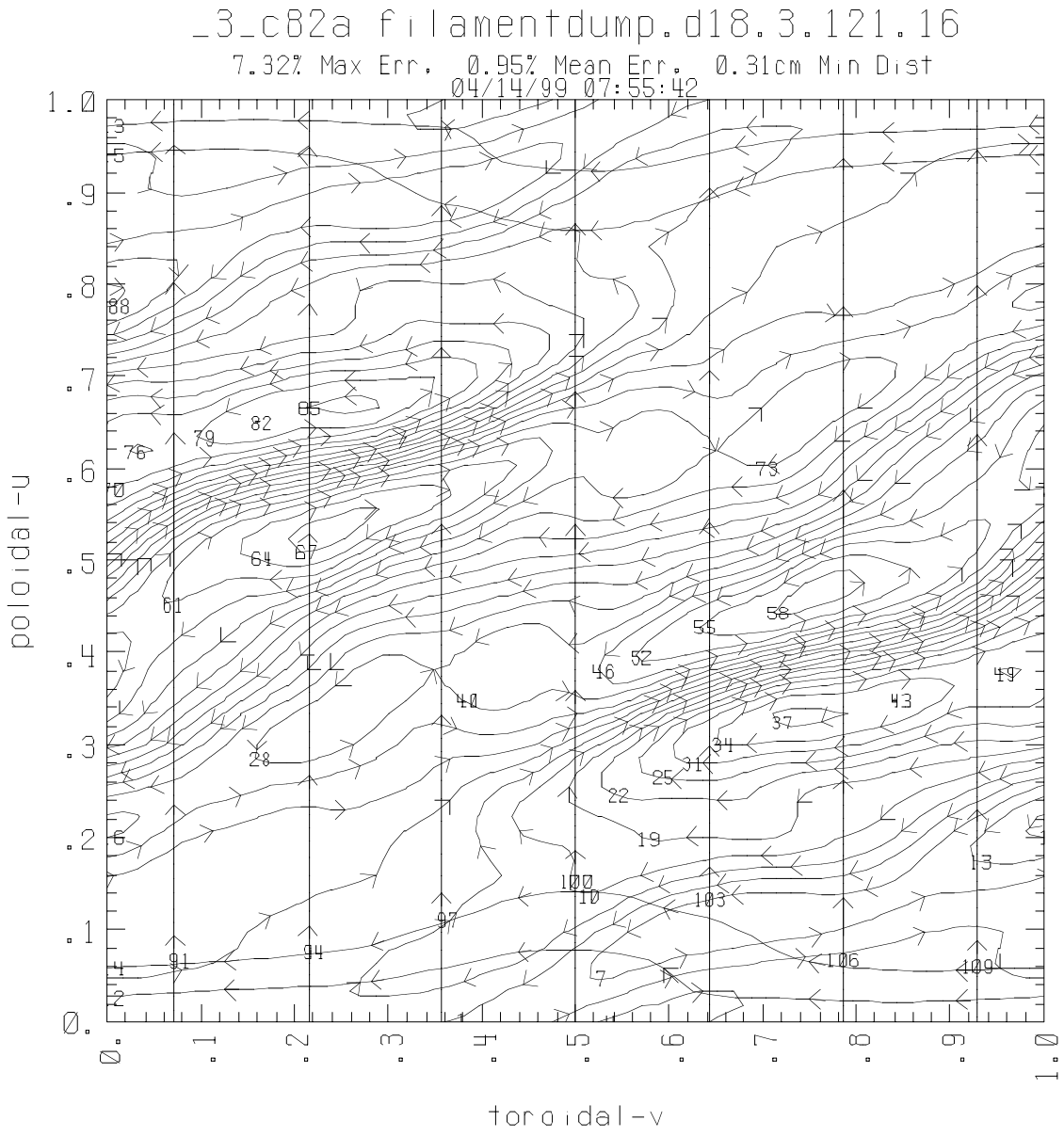
d18.3.121.16 SVD with 8x8 modes, 121 weights retained, 16 uniform contours

d18.3.185.10 SVD with 10x10 modes, 185 weights retained, 10 optimized contours
d18.3.194.10 SVD with 10x10 modes, 194 weights retained, 10 optimized contours

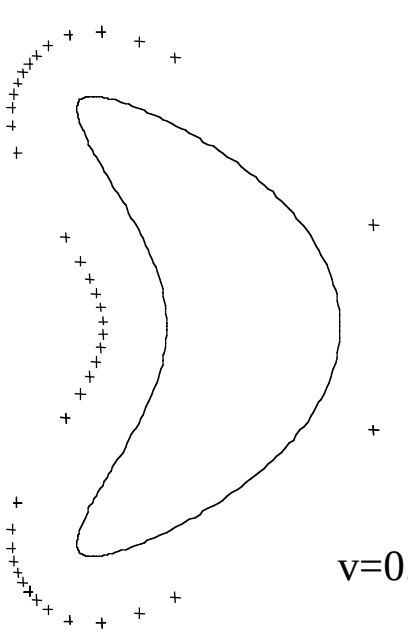
d18.12.201.10 SVD with 10x10 modes, 201 weights retained, targeting |J|^2, 10 optimized contours


Current Potential c82.f88.d18.3
0.0 0.0 ../tfefcoils 50 1 nsvd = 121
Max Value = 1.55E-01
Min Value = -1.55E-01
Contours = 2.82E-02
A=-1.27E-01
B=-9.88E-02
C=-7.05E-02
D=-4.23E-02
E=-1.41E-02
F= 1.41E-02
G= 4.23E-02
H= 7.05E-02
I= 9.88E-02
J= 1.27E-01
poloidal - u
toroidal - v
0.
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0

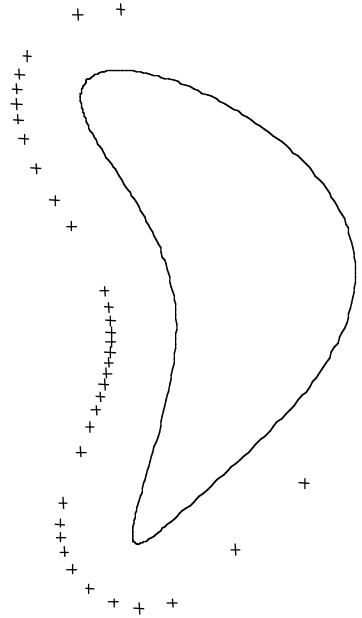
16 uniform contours (30 coils per period)



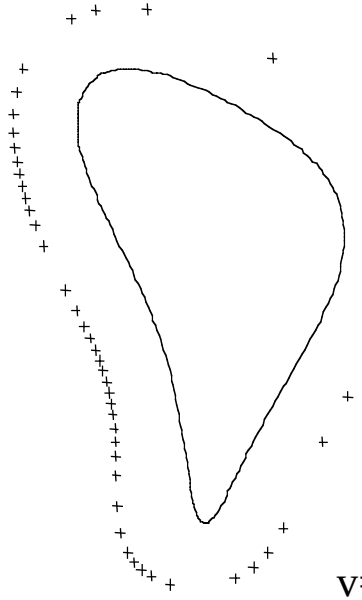
Saddle Coils Filament Locations



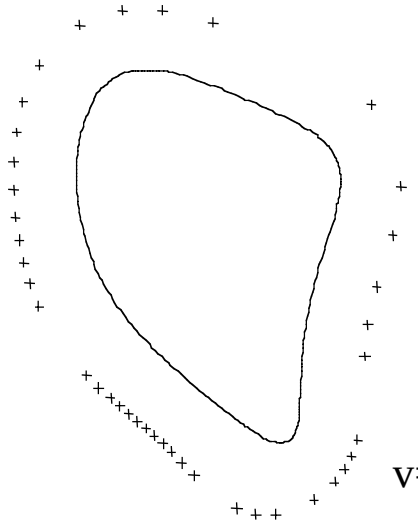
v=0.



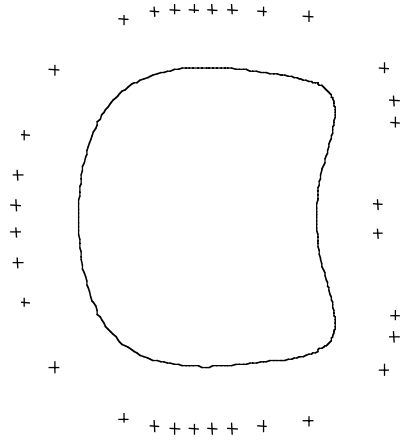
v=.125



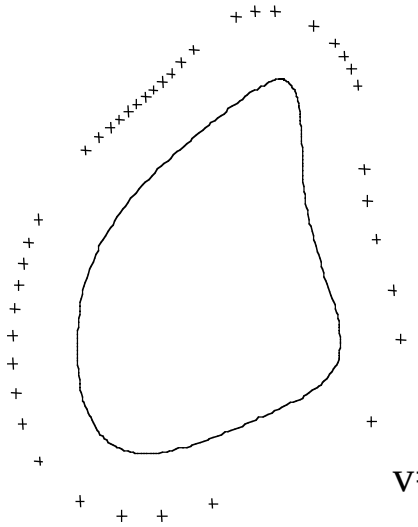
v=.25



v=.375

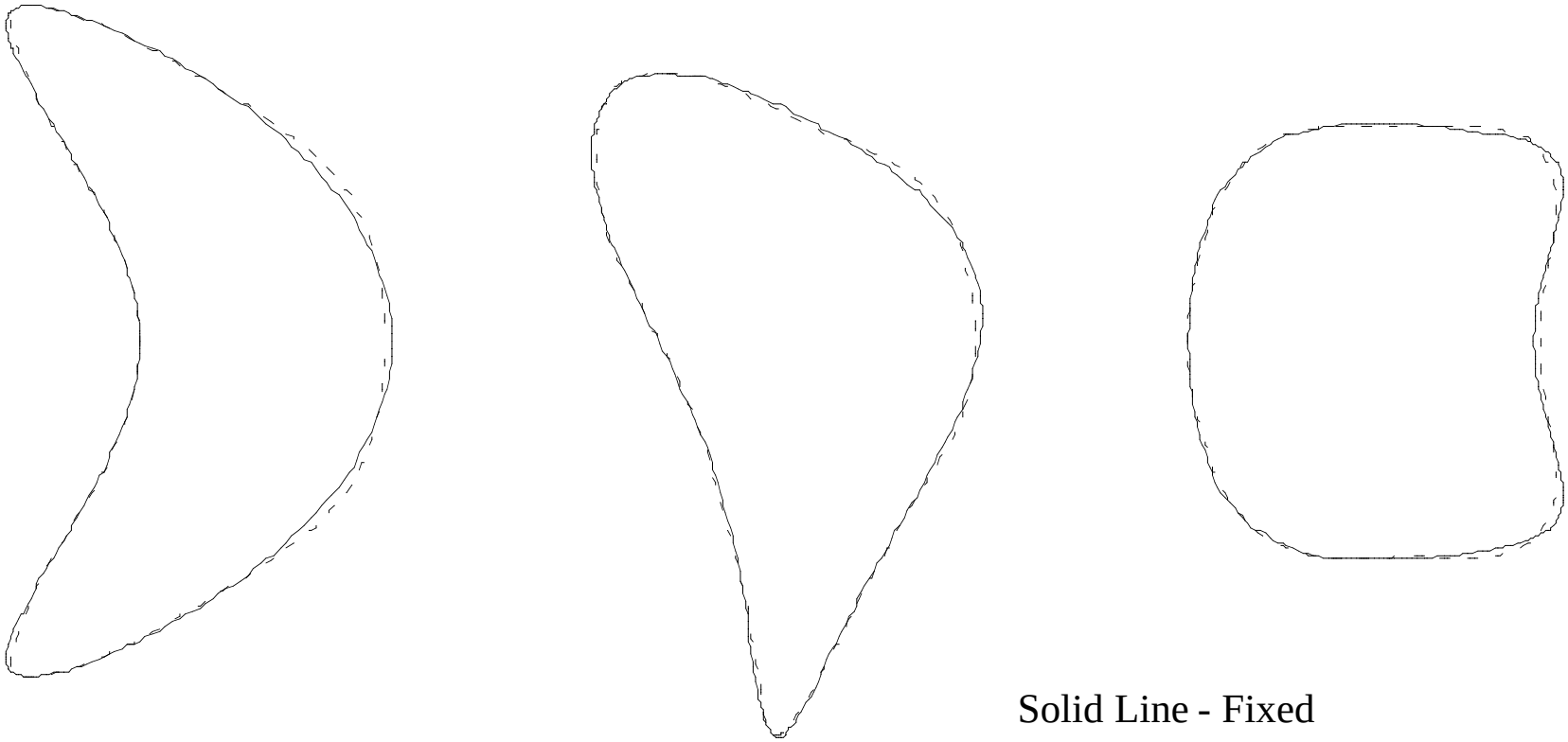


v=.50

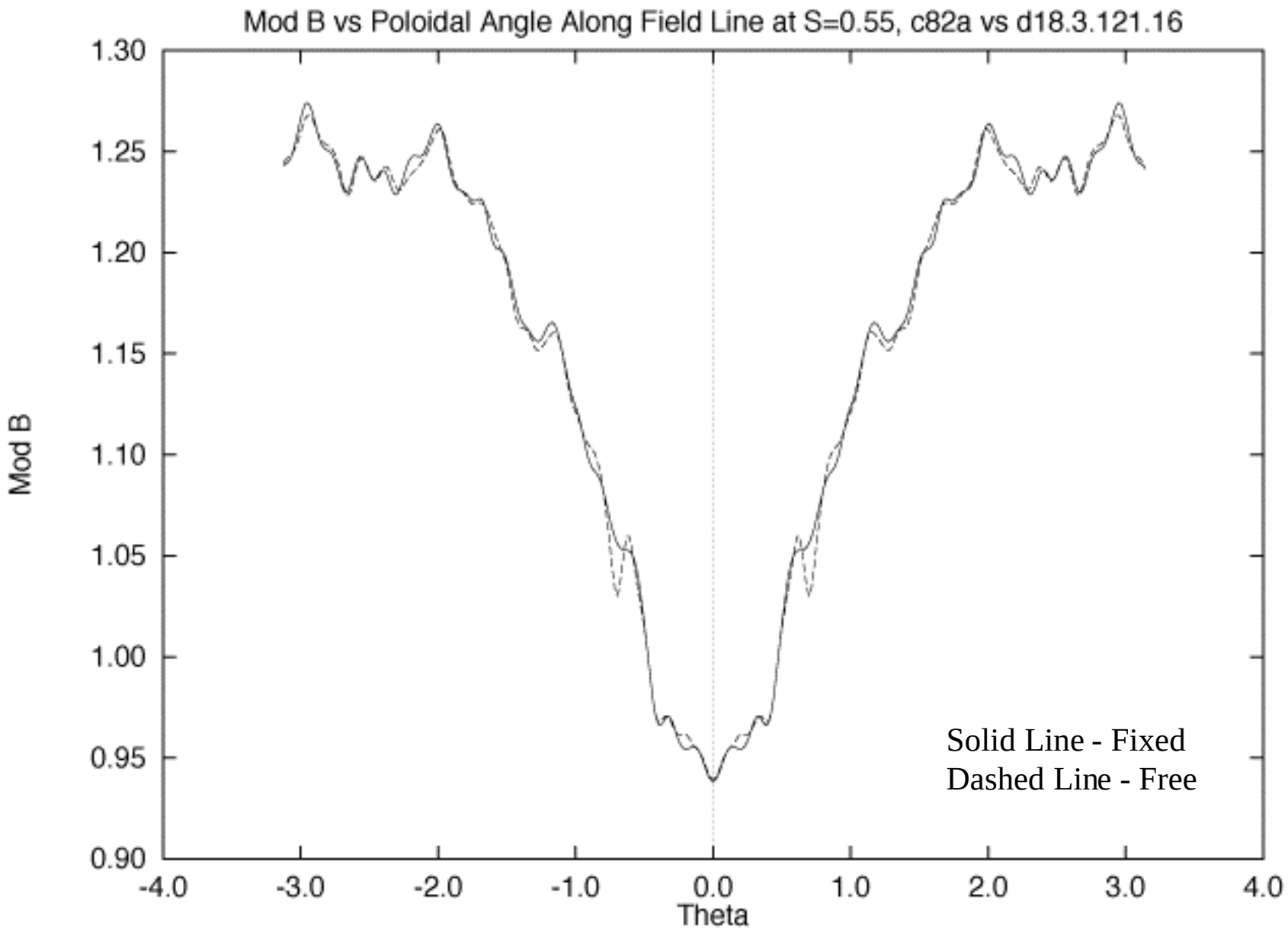


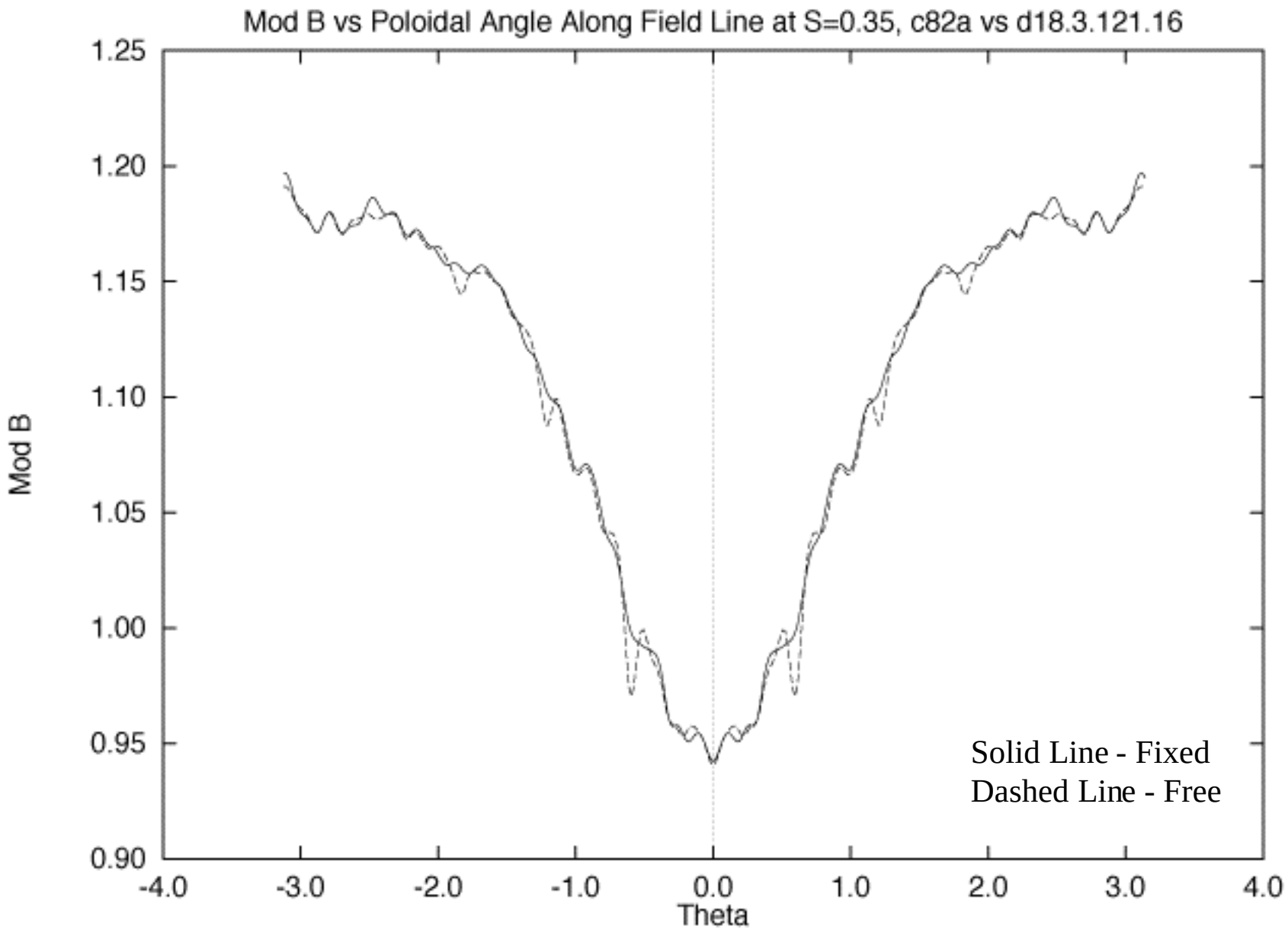
v=.625

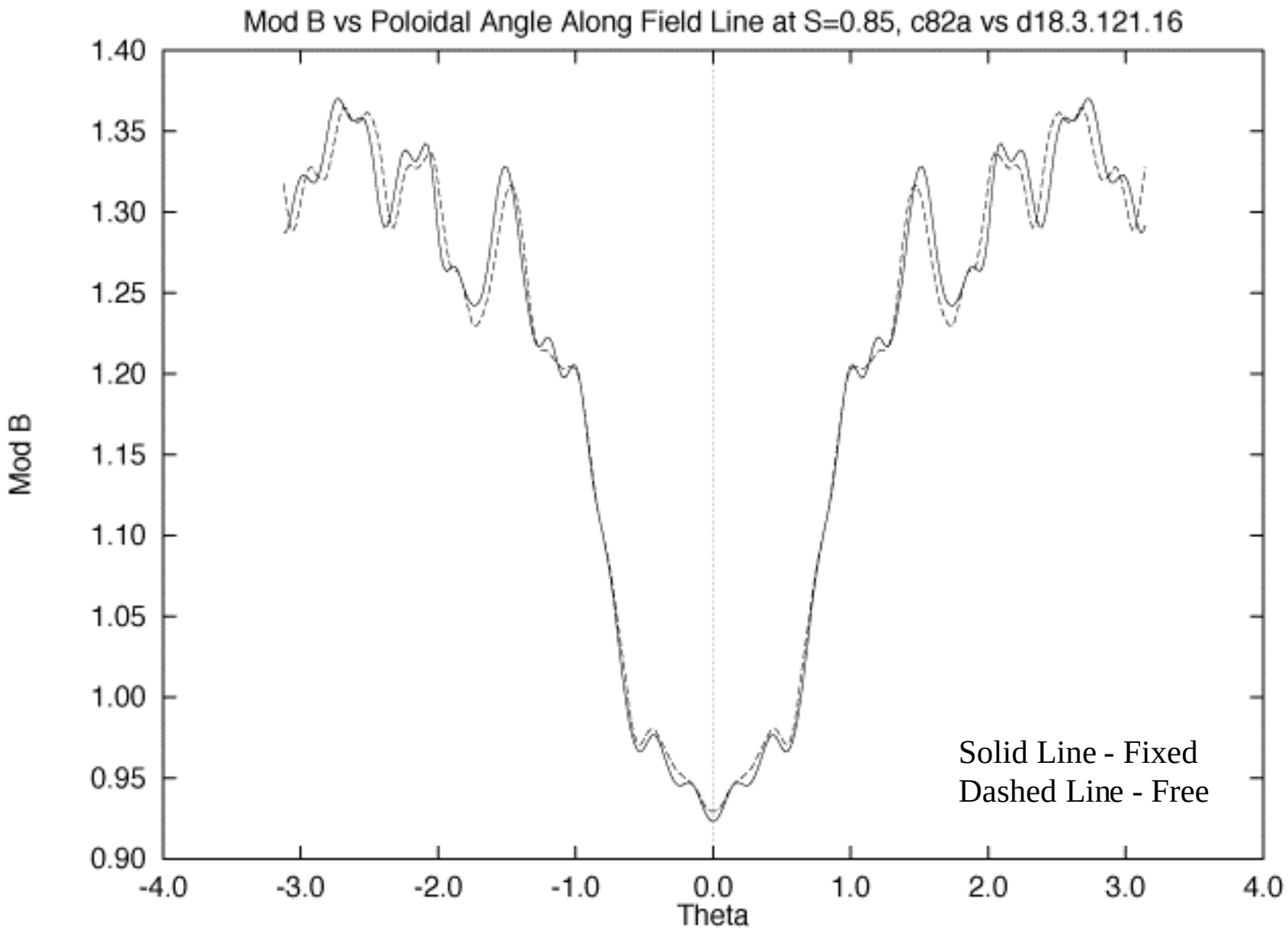
VMEC Reconstruction

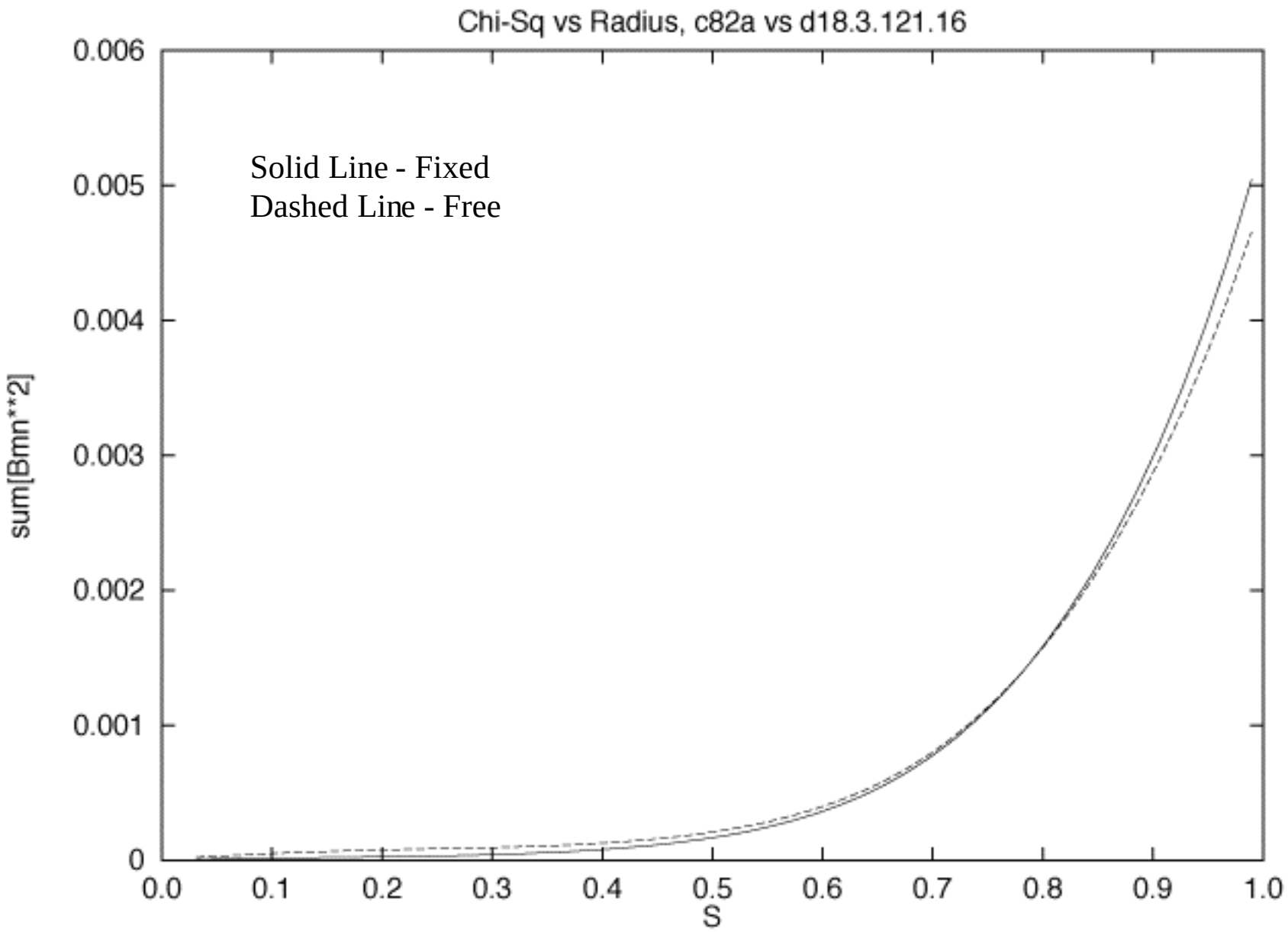


Solid Line - Fixed
Dashed Line - Free


Mod B vs Poloidal Angle Along Field Line at S=0.55, c82a vs d18.3.121.16
Mod B
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Theta
Solid Line - Fixed
Dashed Line - Free


Mod B vs Poloidal Angle Along Field Line at S=0.35, c82a vs d18.3.121.16
Mod B
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Theta
Solid Line - Fixed
Dashed Line - Free


Mod B vs Poloidal Angle Along Field Line at S=0.85, c82a vs d18.3.121.16
Mod B
Theta
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
-4.0
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
Solid Line - Fixed
Dashed Line - Free

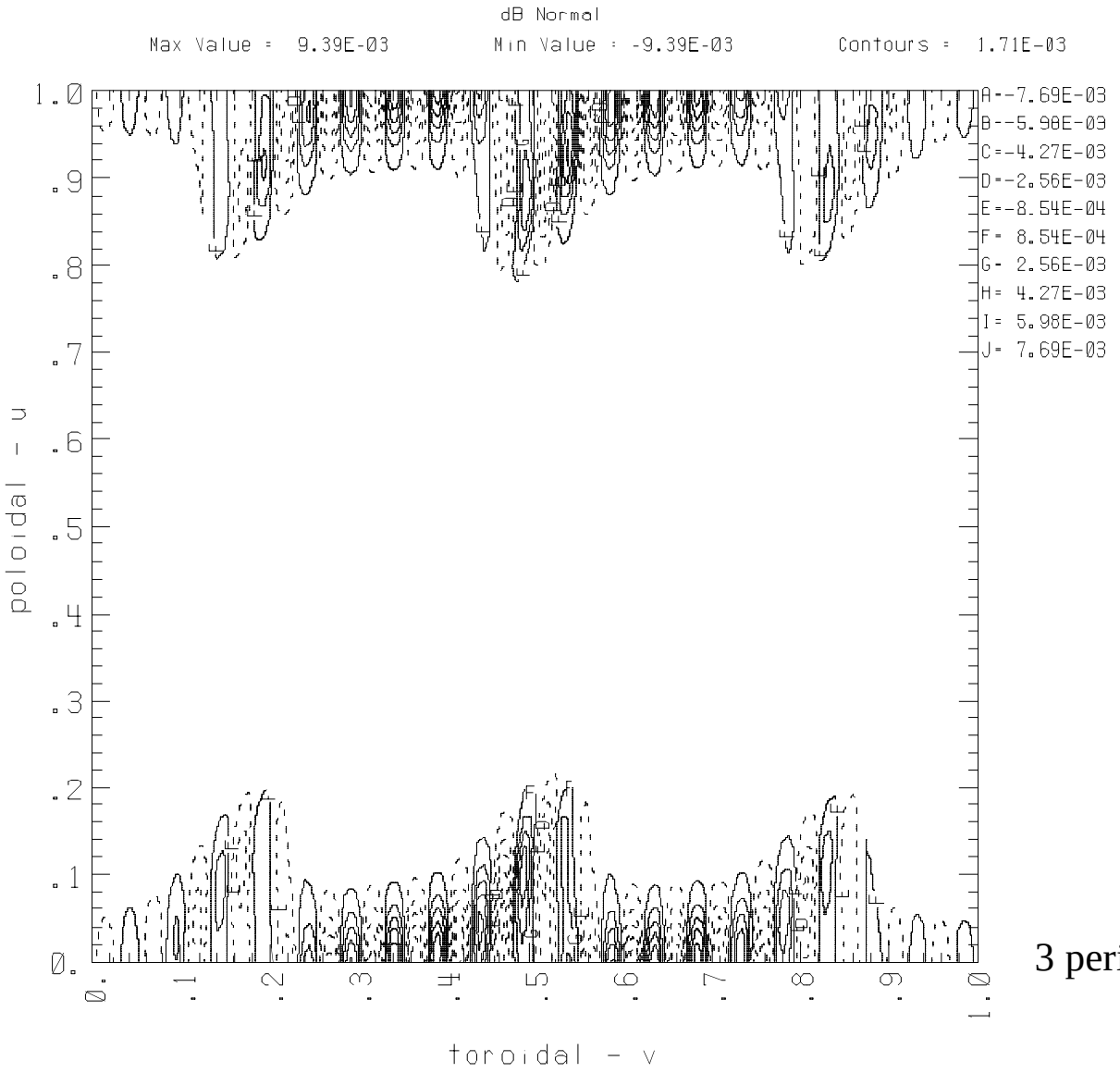

Chi-Sq vs Radius, c82a vs d18.3.121.16
Solid Line - Fixed
Dashed Line - Free
sum[Bmn**2]
S
0.006
0.005
0.004
0.003
0.002
0.001
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Investigation of impact of 20 TF Coils

- Saddle coils have been generated assuming 21 background TF Coils since codes assume all periods equal.
- Field Errors on plasma boundary over 3 periods have been evaluated using the difference field from 20 coils compared to 21 coils.
- Results (fourier modes) show dominant non-symmetric modes (|Bmn|/m) 3 orders of magnitude less than largest saddle symmetric modes

Normal Field on Plasma Boundary

from differential field going from 20 to 21 coils



3 periods

3 Period Field Error on Plasma Boundary

c82 Saddle Coils with 21 TF Coil Set (d18.3.121.16)				Differential Field from 20 TF Coils Set minus 21 TF Coil Set			
m	n	Bmn	|Bmn|/m	m	n	Bmn	|Bmn|/m
8	3	1.94E-03	2.43E-04	5	2	-6.11E-07	1.22E-07
7	3	-1.09E-03	1.56E-04	4	2	-4.77E-07	1.19E-07
6	3	6.59E-04	1.10E-04	11	5	-1.27E-06	1.15E-07
9	3	7.78E-04	8.64E-05	12	5	-1.06E-06	8.84E-08
11	3	3.91E-04	3.56E-05	10	5	-6.57E-07	6.57E-08
12	3	3.76E-04	3.13E-05	12	6	7.74E-07	6.45E-08
13	6	3.65E-04	2.81E-05	11	2	5.50E-07	5.00E-08
10	3	-2.44E-04	2.44E-05	12	2	4.56E-07	3.80E-08
12	6	2.78E-04	2.31E-05	11	3	-4.12E-07	3.75E-08
14	3	-1.92E-04	1.37E-05	7	2	2.52E-07	3.60E-08
18	3	-2.22E-04	1.23E-05	10	2	3.32E-07	3.32E-08
14	6	1.14E-04	8.17E-06	15	2	-4.89E-07	3.26E-08
19	6	-1.40E-04	7.36E-06	15	5	4.63E-07	3.09E-08
17	3	-1.23E-04	7.25E-06	14	2	-4.09E-07	2.92E-08
16	3	1.05E-04	6.56E-06	14	5	4.04E-07	2.89E-08
19	3	-1.18E-04	6.21E-06	8	2	2.28E-07	2.85E-08
18	6	-8.65E-05	4.81E-06	12	3	-3.32E-07	2.77E-08
20	9	-9.58E-05	4.79E-06	6	2	-1.60E-07	2.66E-08
15	6	-6.99E-05	4.66E-06	10	3	-2.59E-07	2.59E-08
13	3	-5.34E-05	4.11E-06	7	3	-1.72E-07	2.46E-08
20	6	-7.81E-05	3.90E-06	15	3	3.51E-07	2.34E-08