Edge Magnetic Field Structure Mapping

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UCSD

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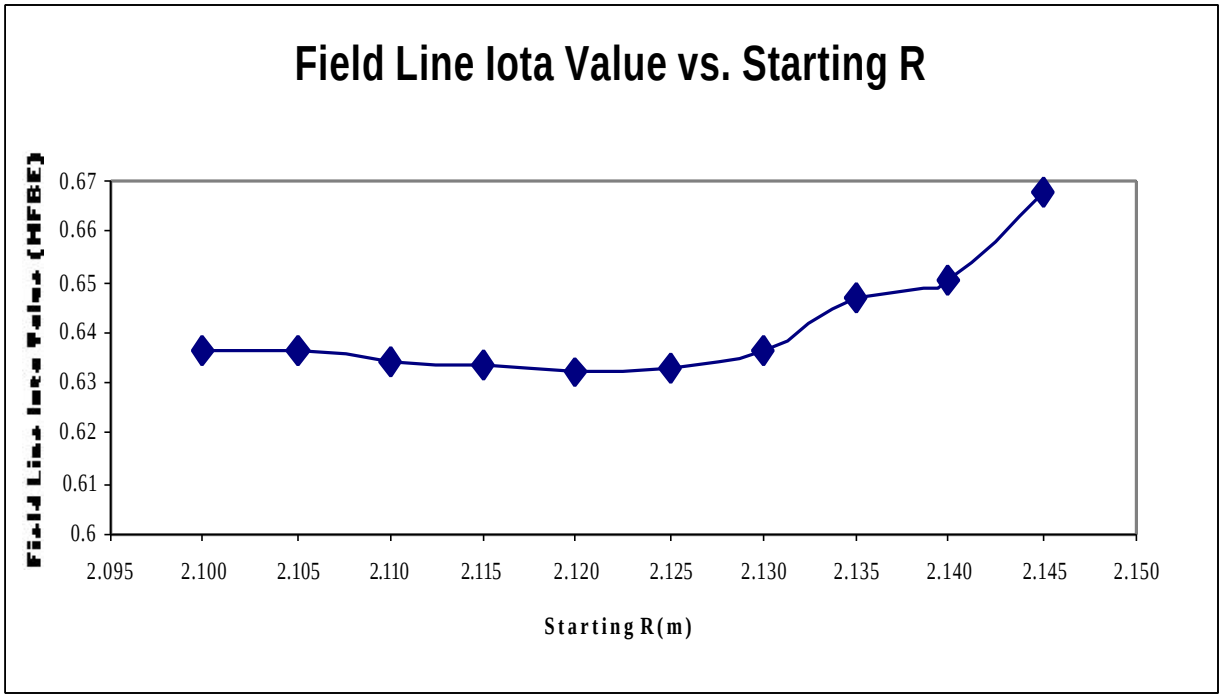
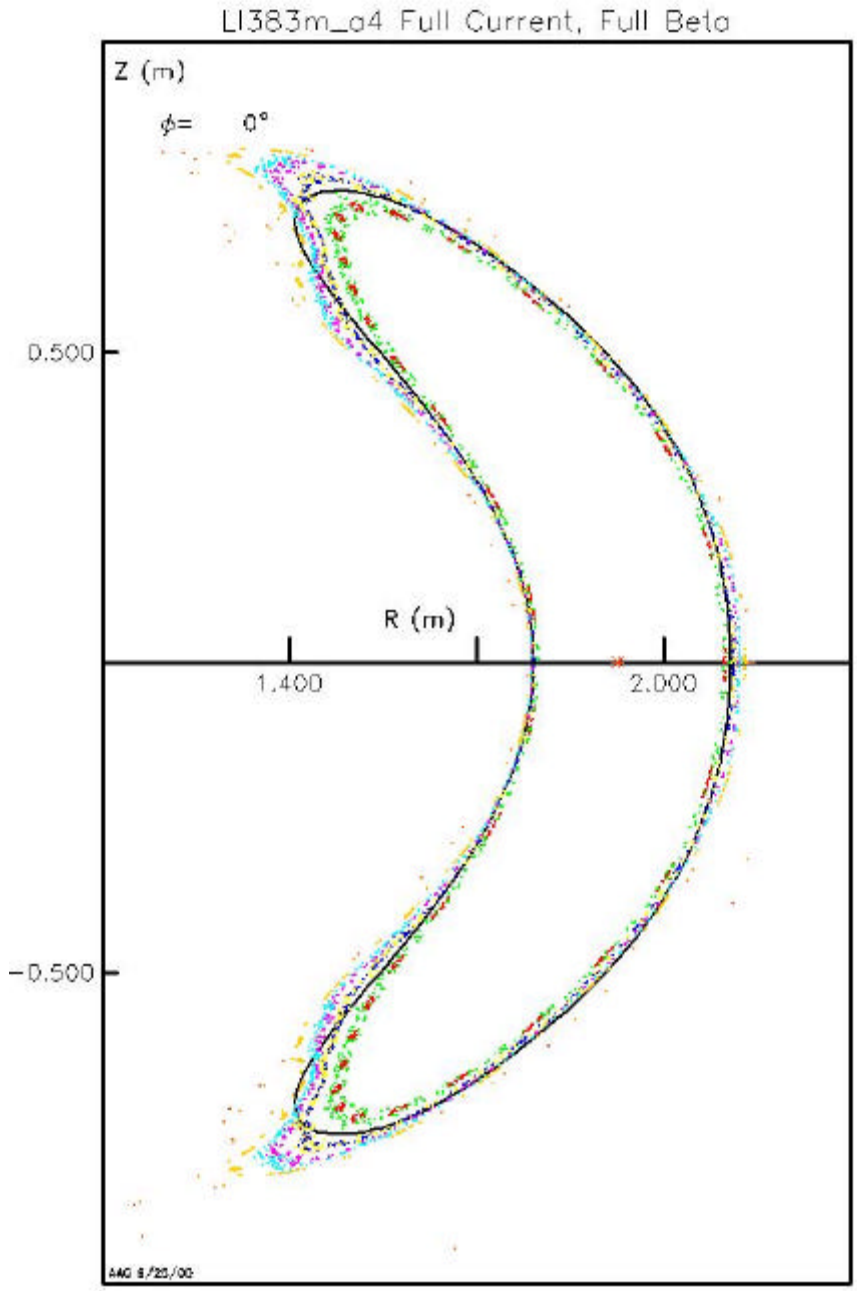
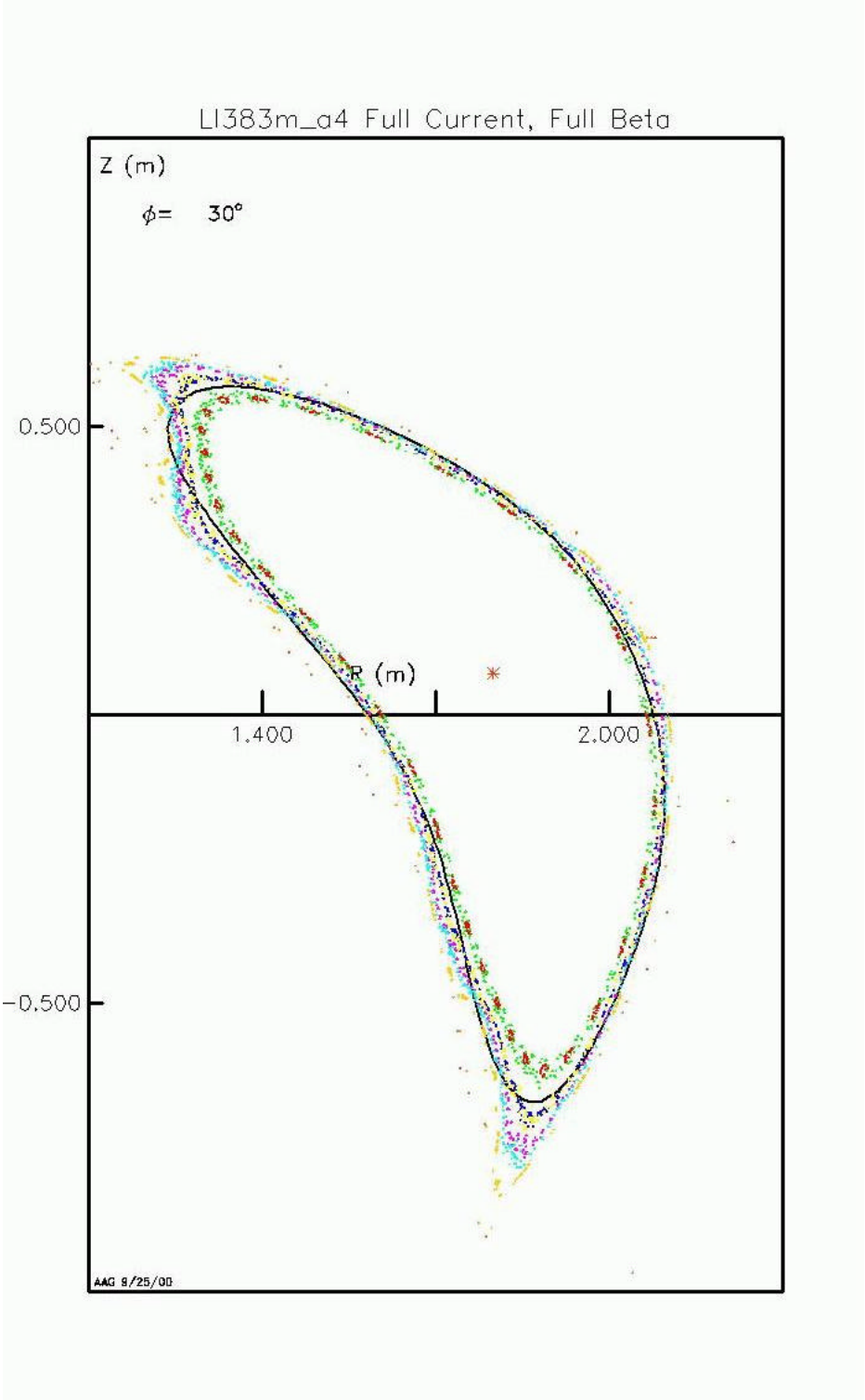
NCSX Project Meeting

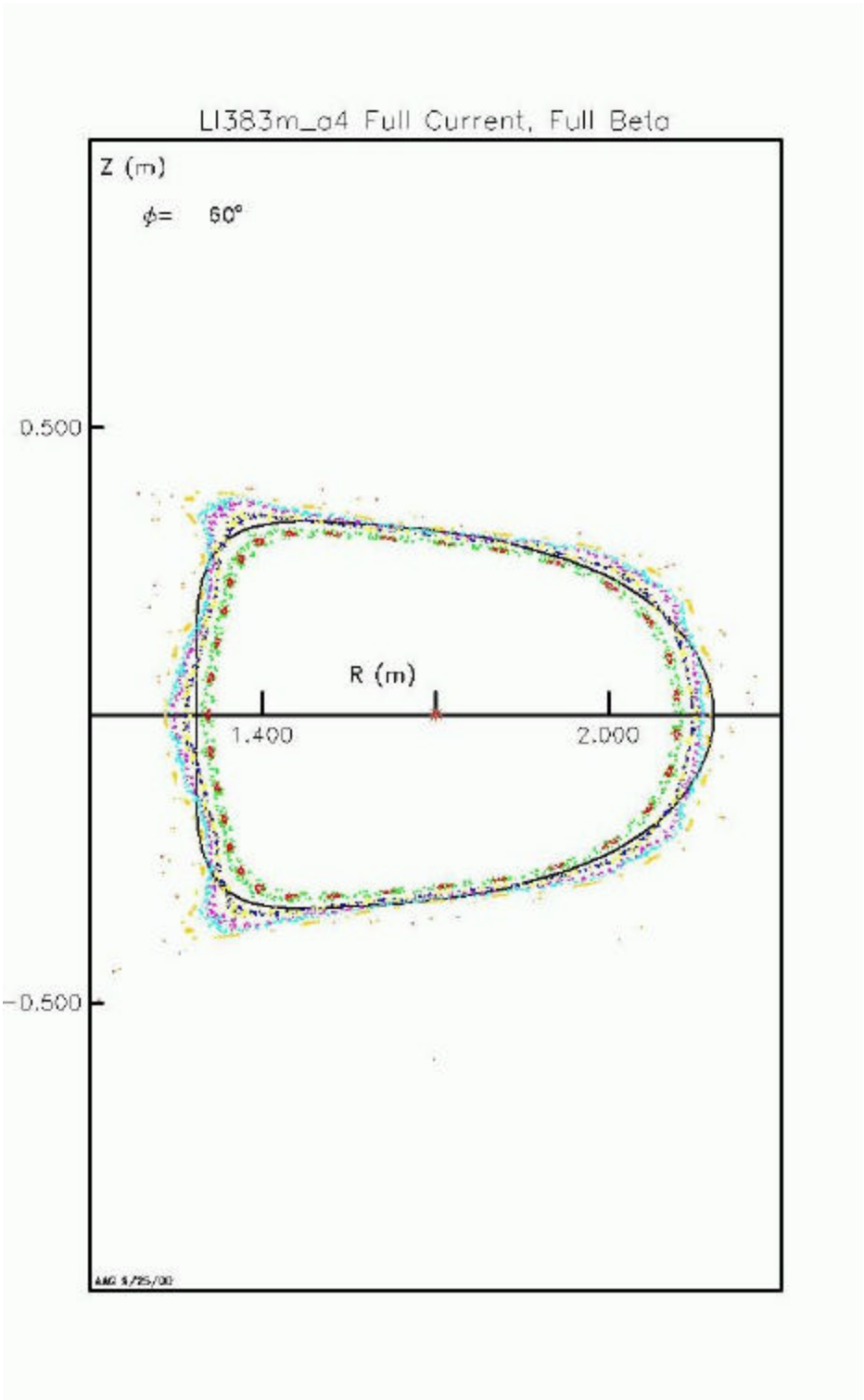
LI383m_a4: Modular Full Current, Full Beta 10-Field Line Tracing

Modular Full Beta, Full Current						
Traced Line Numbe	Starting point R(m) [Z=0]	Iota-value of traced field line	LSS (MFB	Number of Toroidal Turns	Color	
1	2.100	0.636439	72001	200	Red	
2	2.105	0.636416	72001	200	Green	
3	2.110	0.634085	72001	200	Blue	
4	2.115	0.633815	72001	200	yellow	
5	2.120	0.632366	72001	200	pink	
6	2.125	0.632801	72001	200	lightblue	
7	2.130	0.636642	72001	200	orange1 (yellow)	
8	2.135	0.646951	4501	13	orange2	
9	2.140	0.650745	2800	8	orange3	
10	2.145	0.668243	1142	3	orange4 (red)	

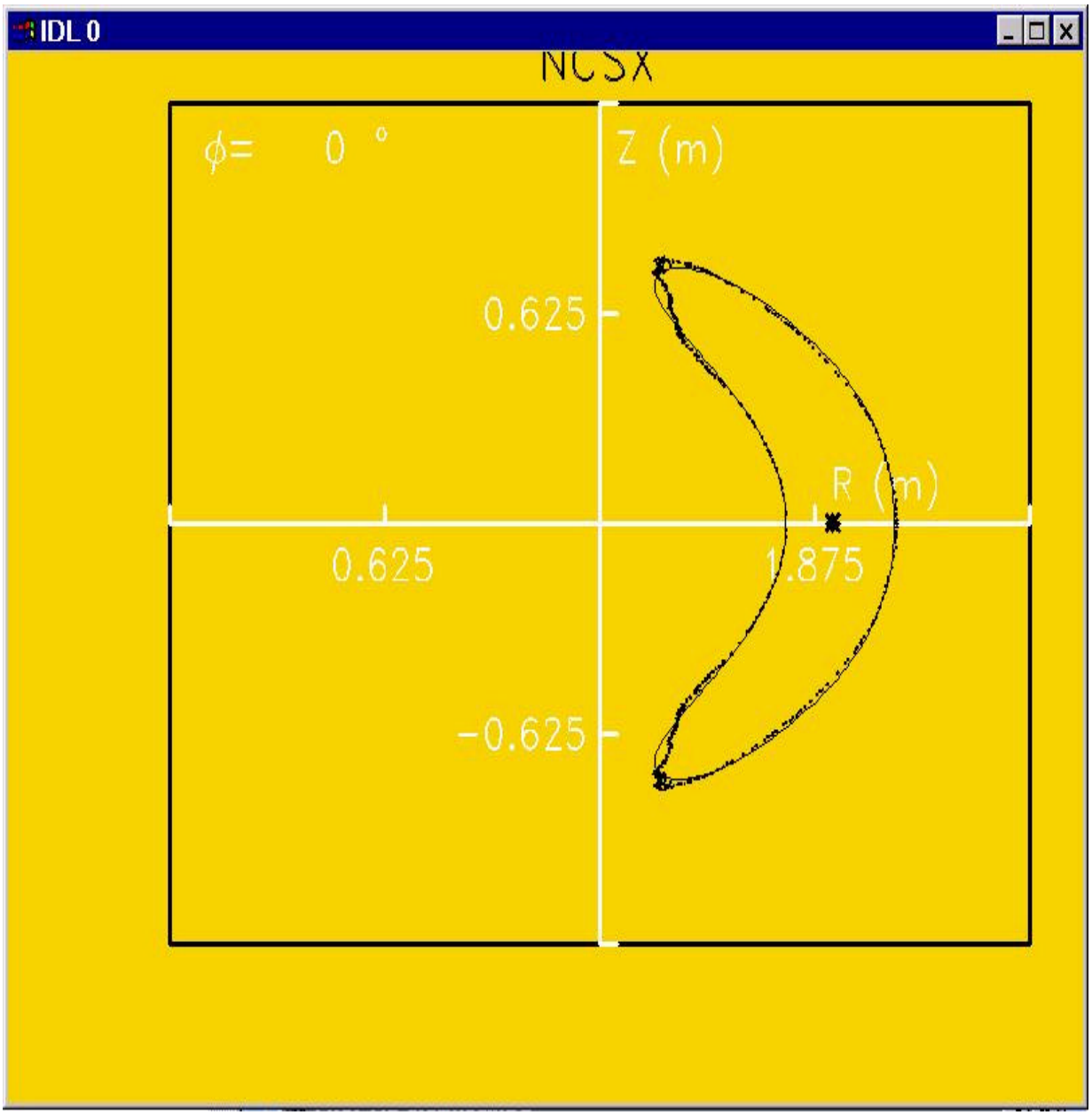



LI383m_a4 Full Current, Full Beta
Z (m)
ϕ= 0°
0.500
R (m)
1.400
2.000
−0.500
AAG 9/25/00

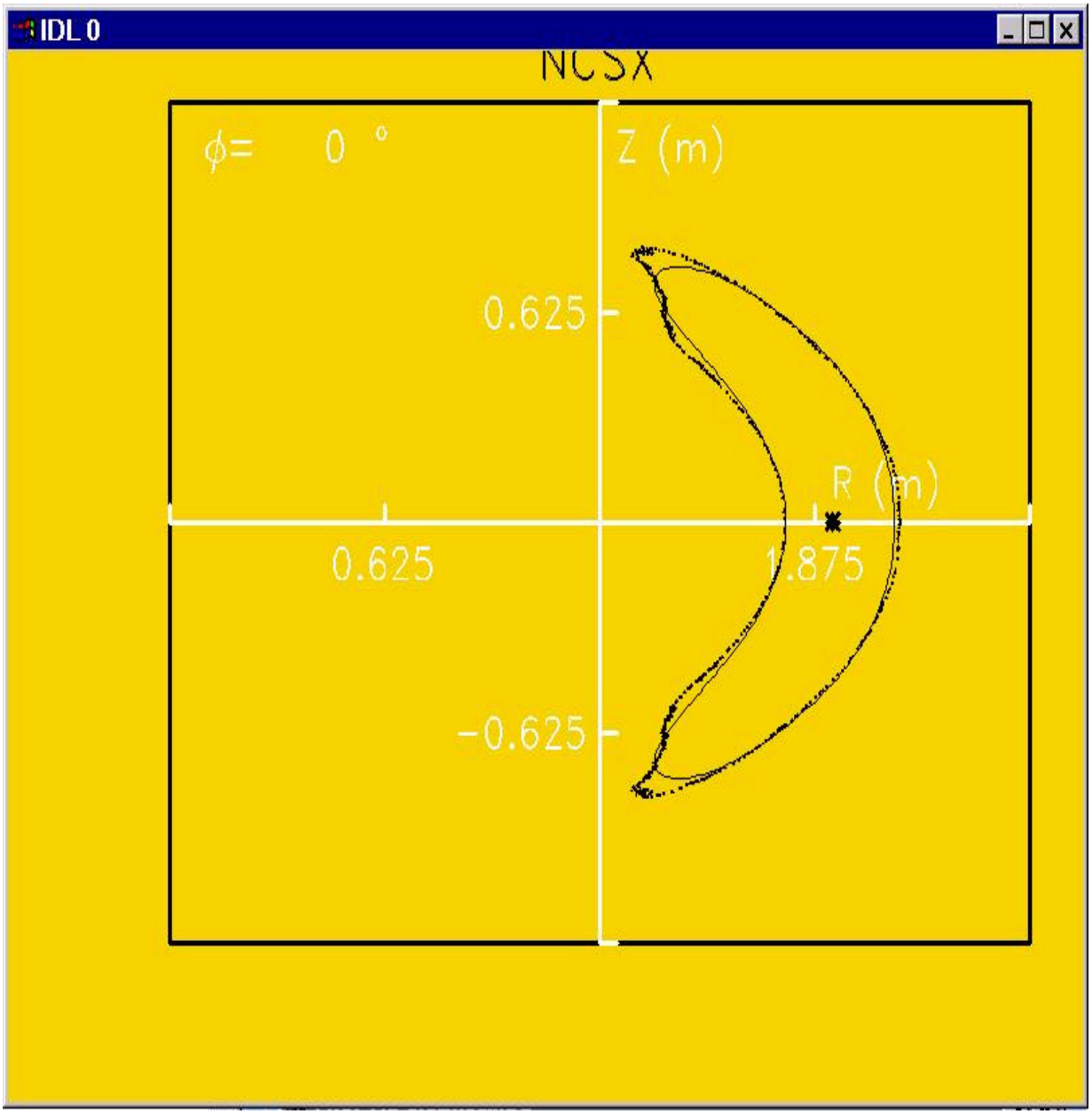

LI383m_a4 Full Current, Full Beta
Z (m)
ϕ= 30°
0.500
−0.500
R (m)
1.400
2.000
AAG 9/25/00


LI383m_a4 Full Current, Full Beta
Z (m)
ϕ= 60°
0.500
R (m)
1.400
2.000
−0.500
AAG 9/25/00

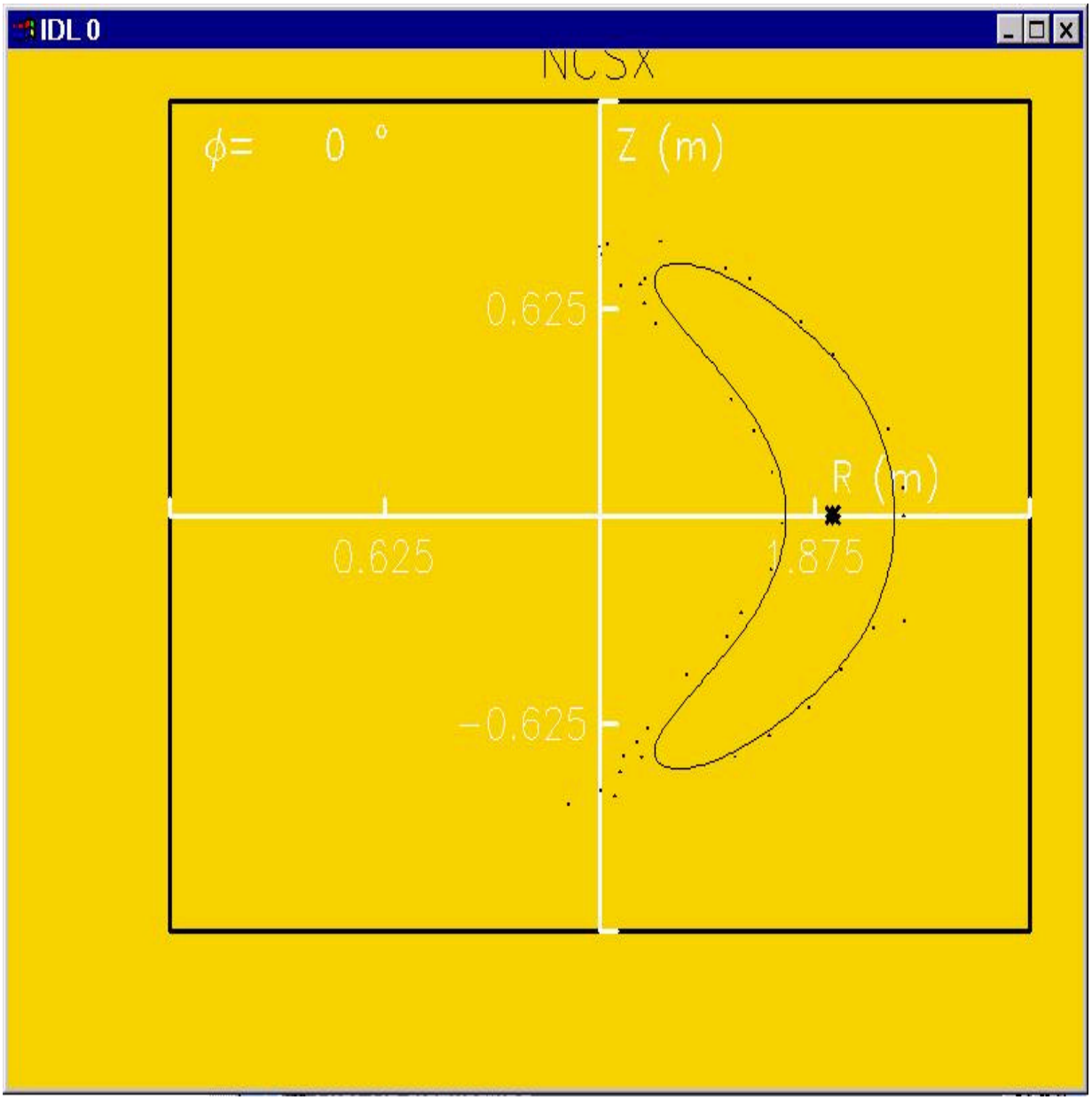
Single Field Line Started at R=2.115, Z=0 and VMEC LCMS(solid curve) LI383m_a4



Single Field Line Started at R=2.125, Z=0 and VMEC LCMS(solid curve) LI383m_a4

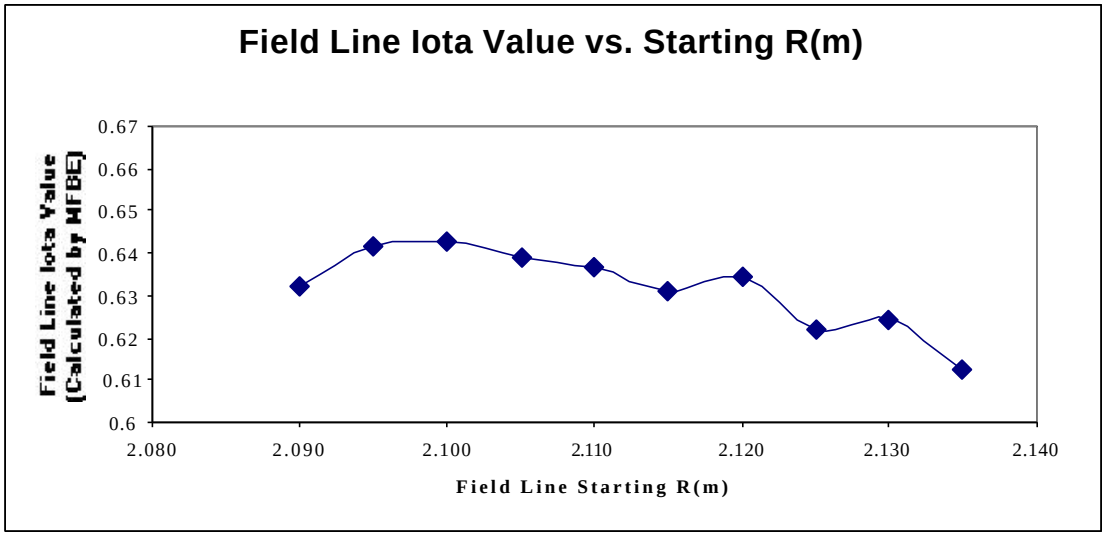


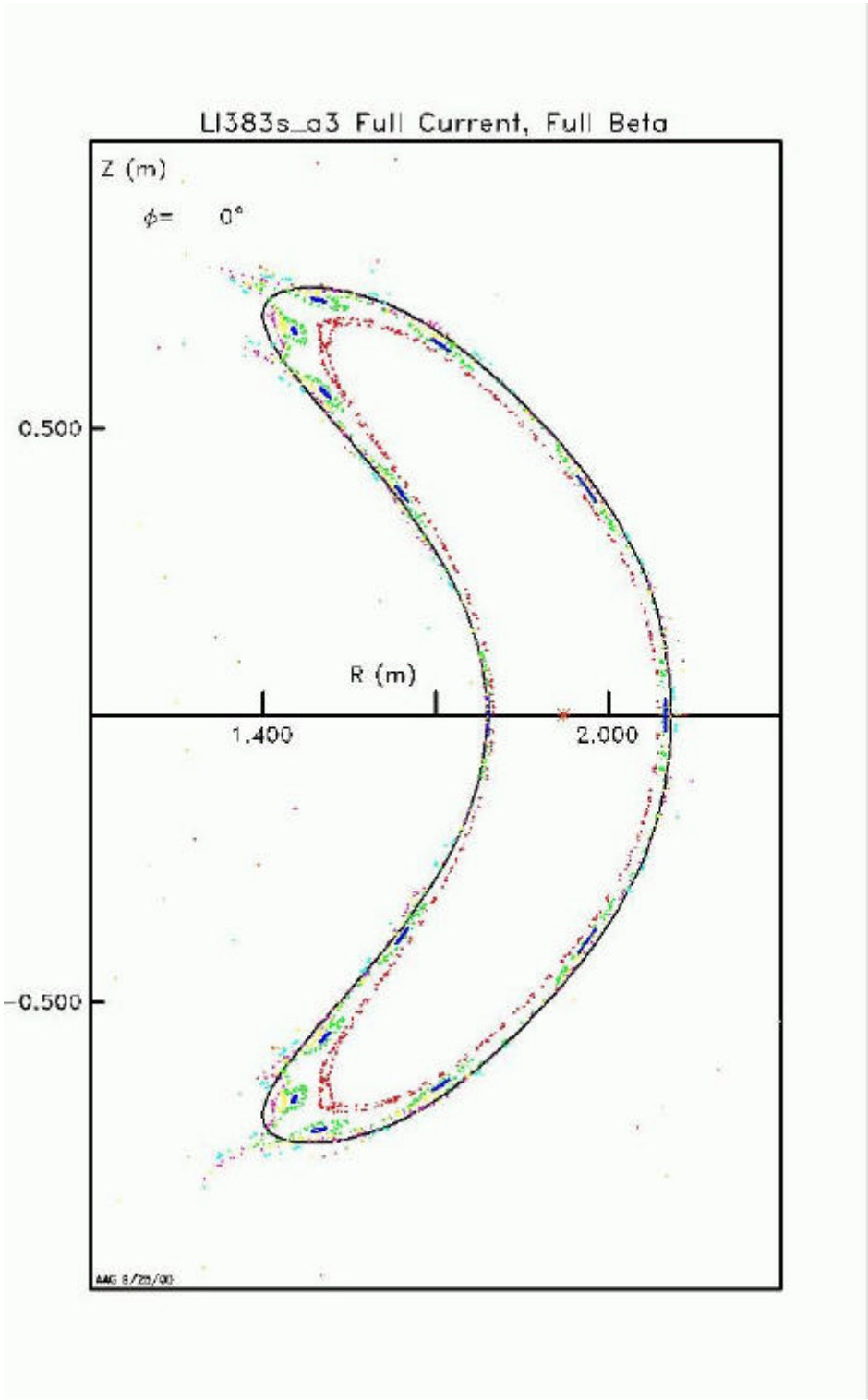
Single Field Line Started at R=2.135, Z=0 and VMEC LCMS(solid curve) LI383m_a4

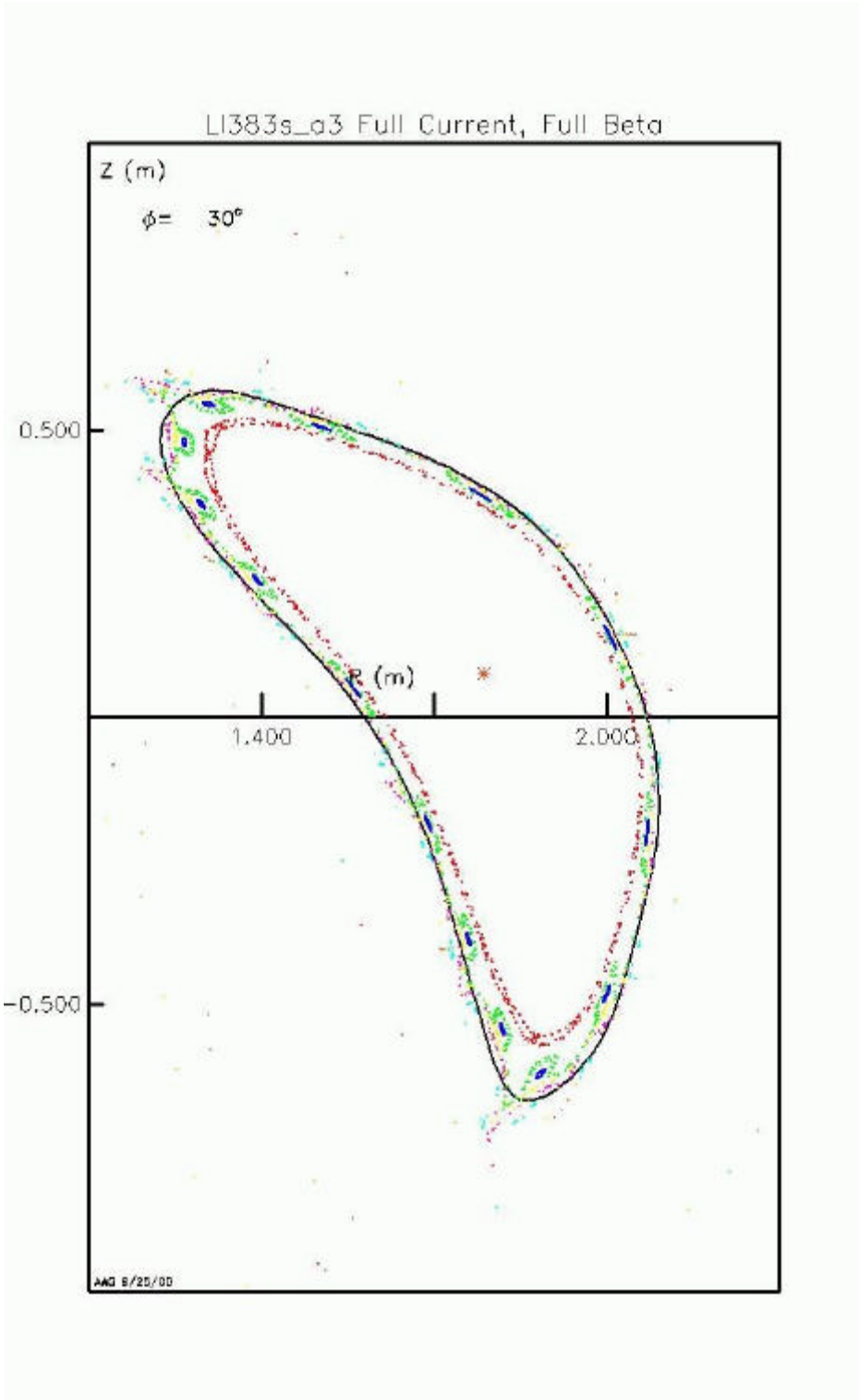


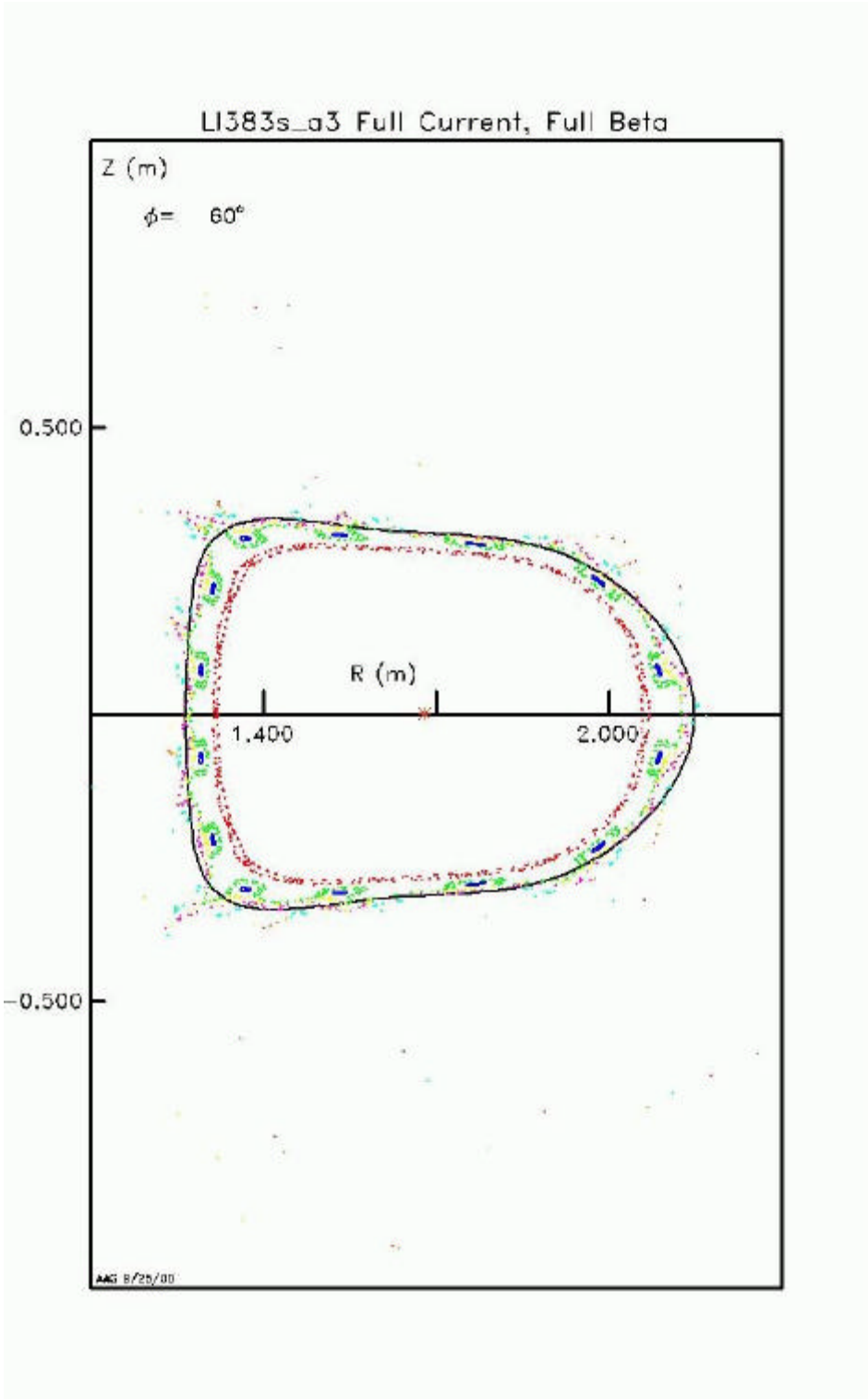
LI383s_a3: Saddle Coils Full Current, Full Beta 10-Field Line Tracing

Traced Line Numbe	Starting point R(m) [Z=0]	Iota-value of traced field line	LSS (MFBE)	Number of Toroidal Turns	Color
1	2.090	0.631945	72001	200	Green
2	2.095	0.641565	72001	200	Blue
3	2.100	0.642775	72001	200	yellow
4	2.105	0.638914	45467	126	pink
5	2.110	0.636702	31722	88	lightblue
6	2.115	0.630956	28255	78	orange1 (y
7	2.120	0.634475	2214	6	orange2
8	2.125	0.621955	1812	5	orange3
9	2.130	0.624278	1361	4	orange4 (r
10	2.135	0.612351	1879	5	orange4 (r

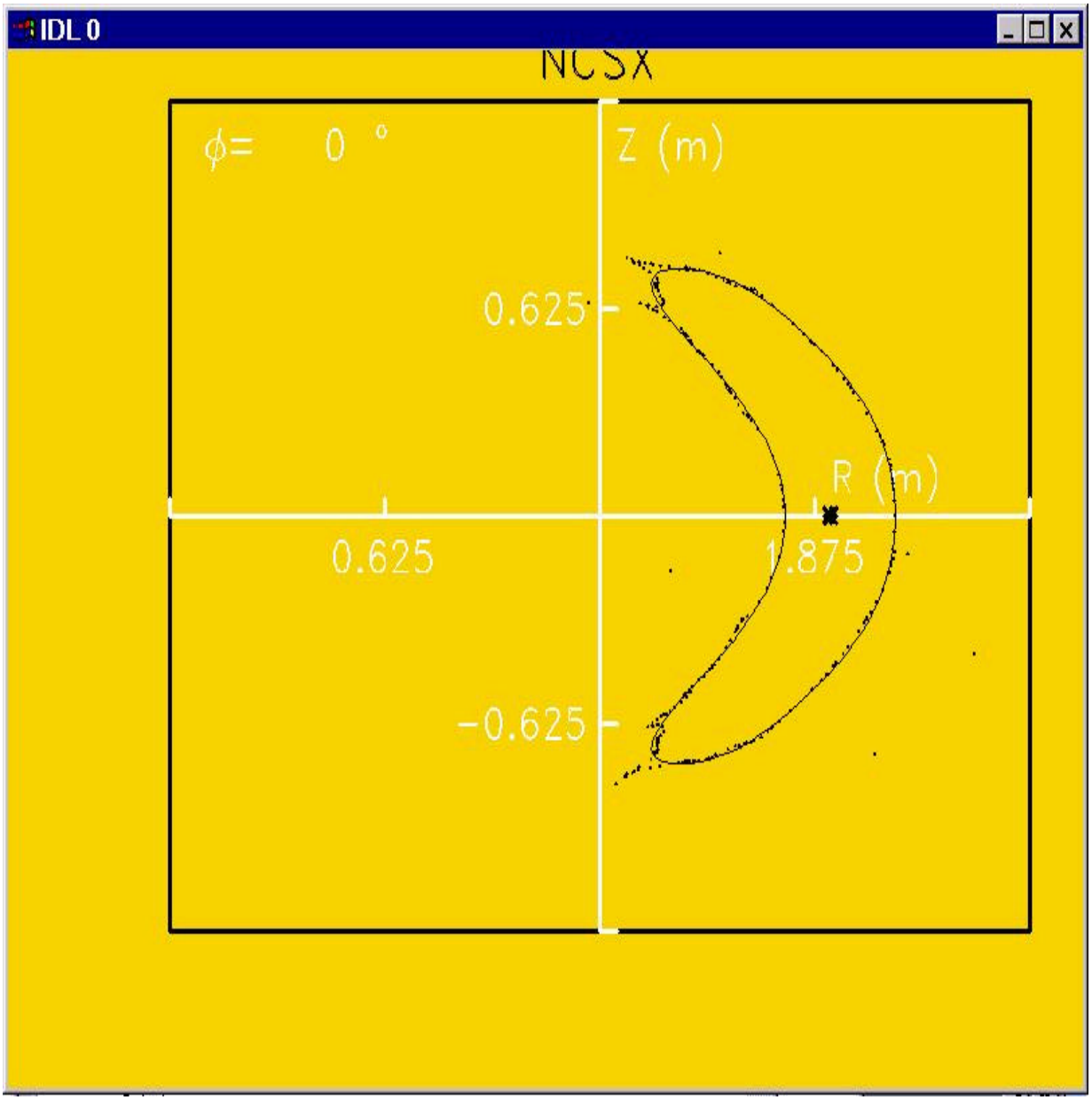



LI383s_a3 Full Current, Full Beta
Z (m)
ϕ= 0°
0.500
R (m)
1.400
2.000
−0.500
AAG 8/25/00

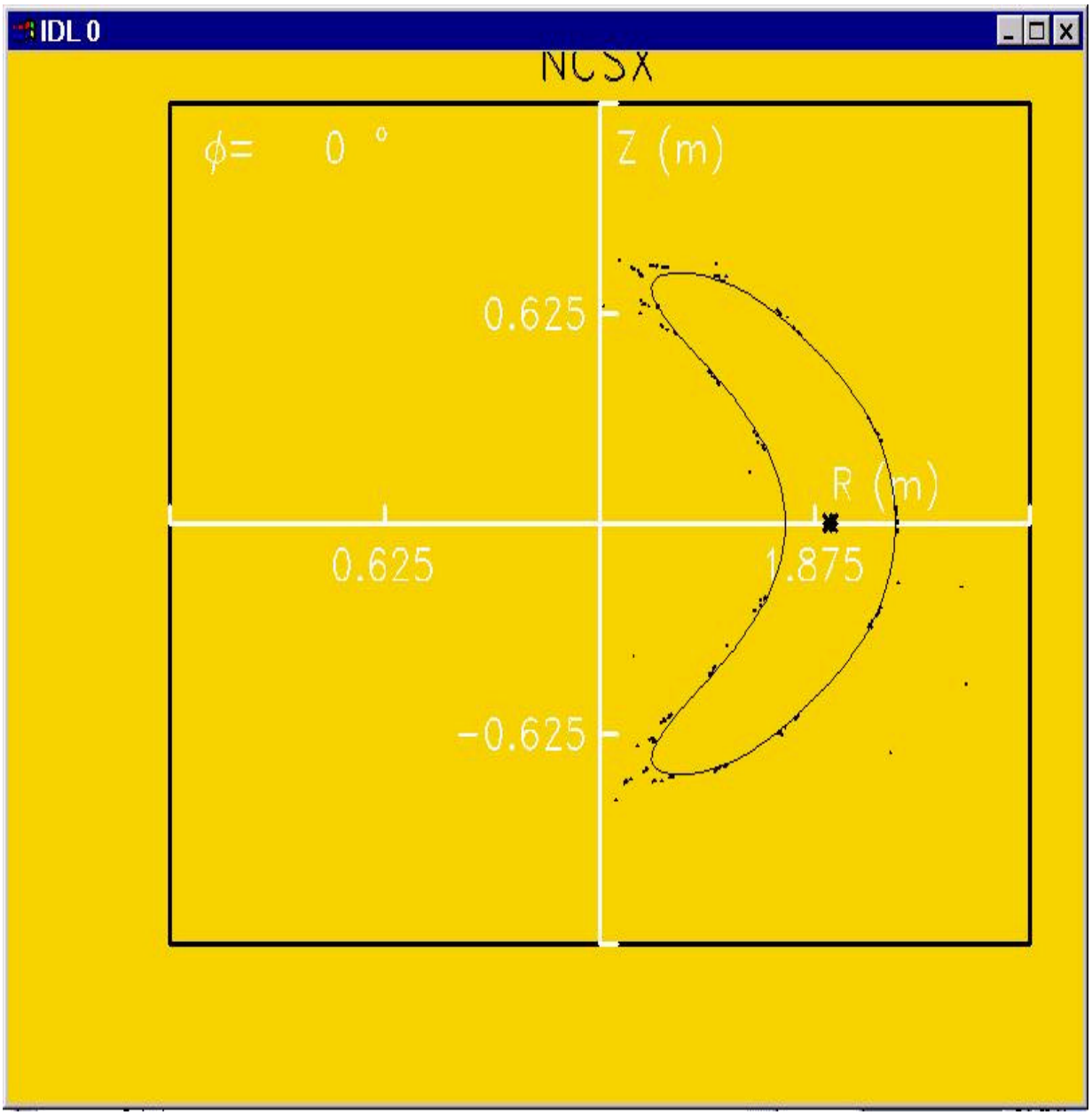

LI383s_a3 Full Current, Full Beta
Z (m)
ϕ= 30°
0.500
-0.500
R (m)
1.400
2.000
AAG 9/25/00


LI383s_a3 Full Current, Full Beta
Z (m)
ϕ= 60°
0.500
−0.500
R (m)
1.400
2.000
AAG 9/25/00

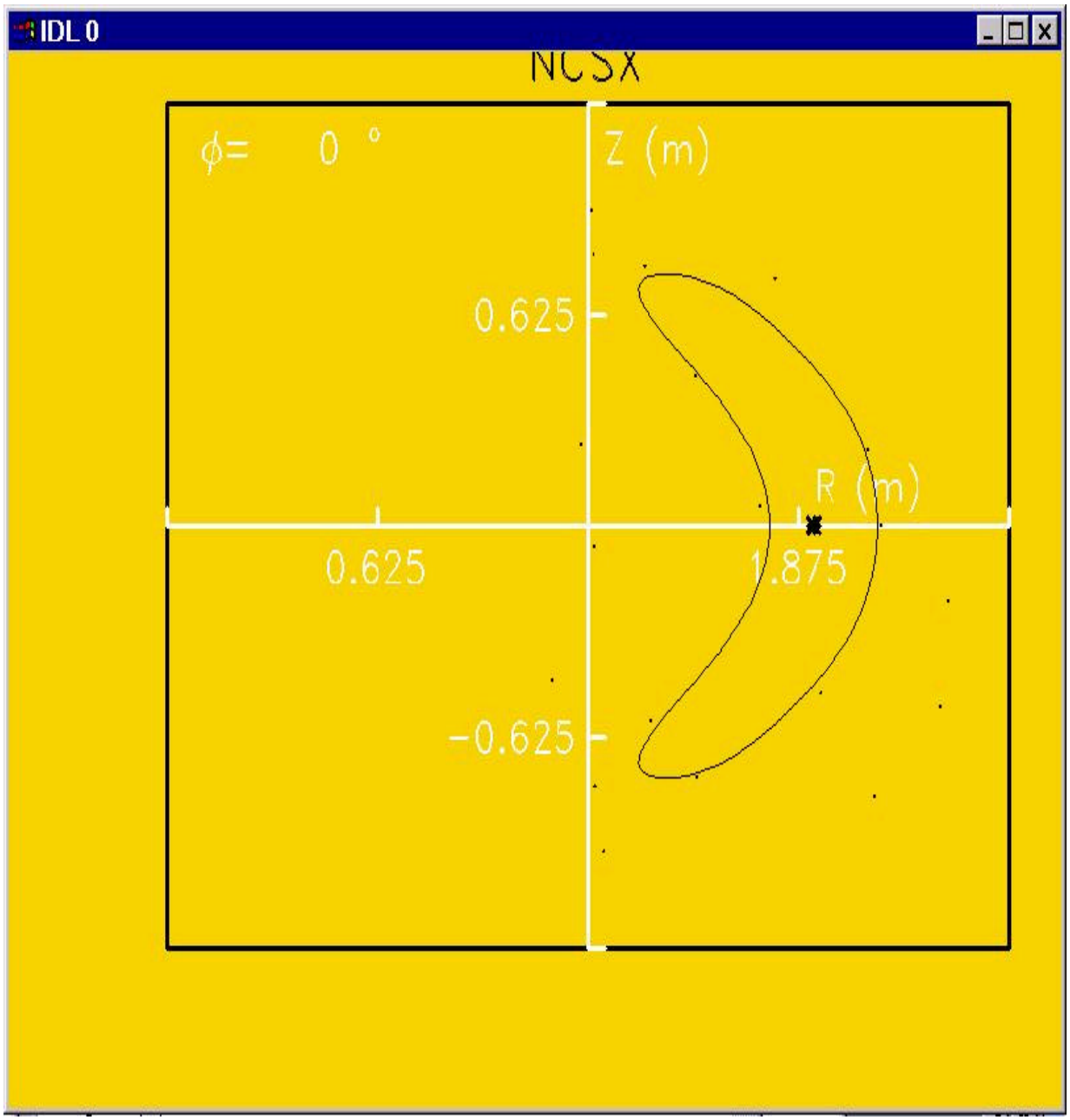
Single Field Line Started at R=2.110, Z=0 and VMEC LCMS (solid curve) LI383s_a3



Single Field Line Started at R=2.115, Z=0 and VMEC LCMS (solid curve) LI383s_a3

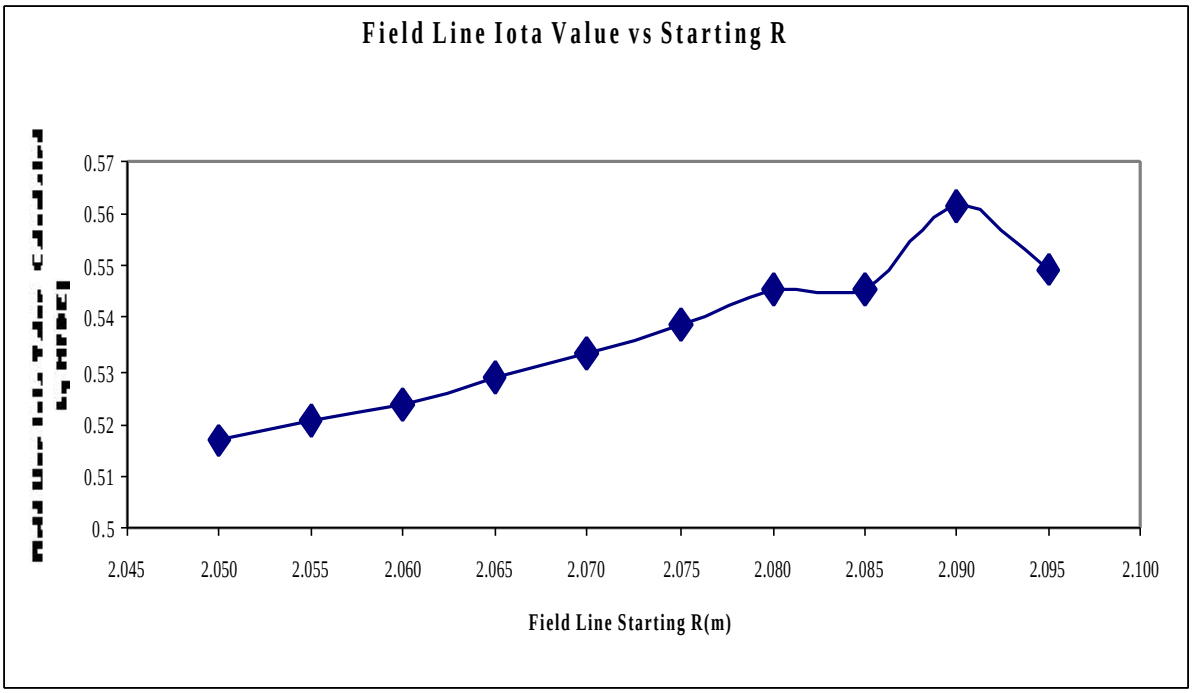


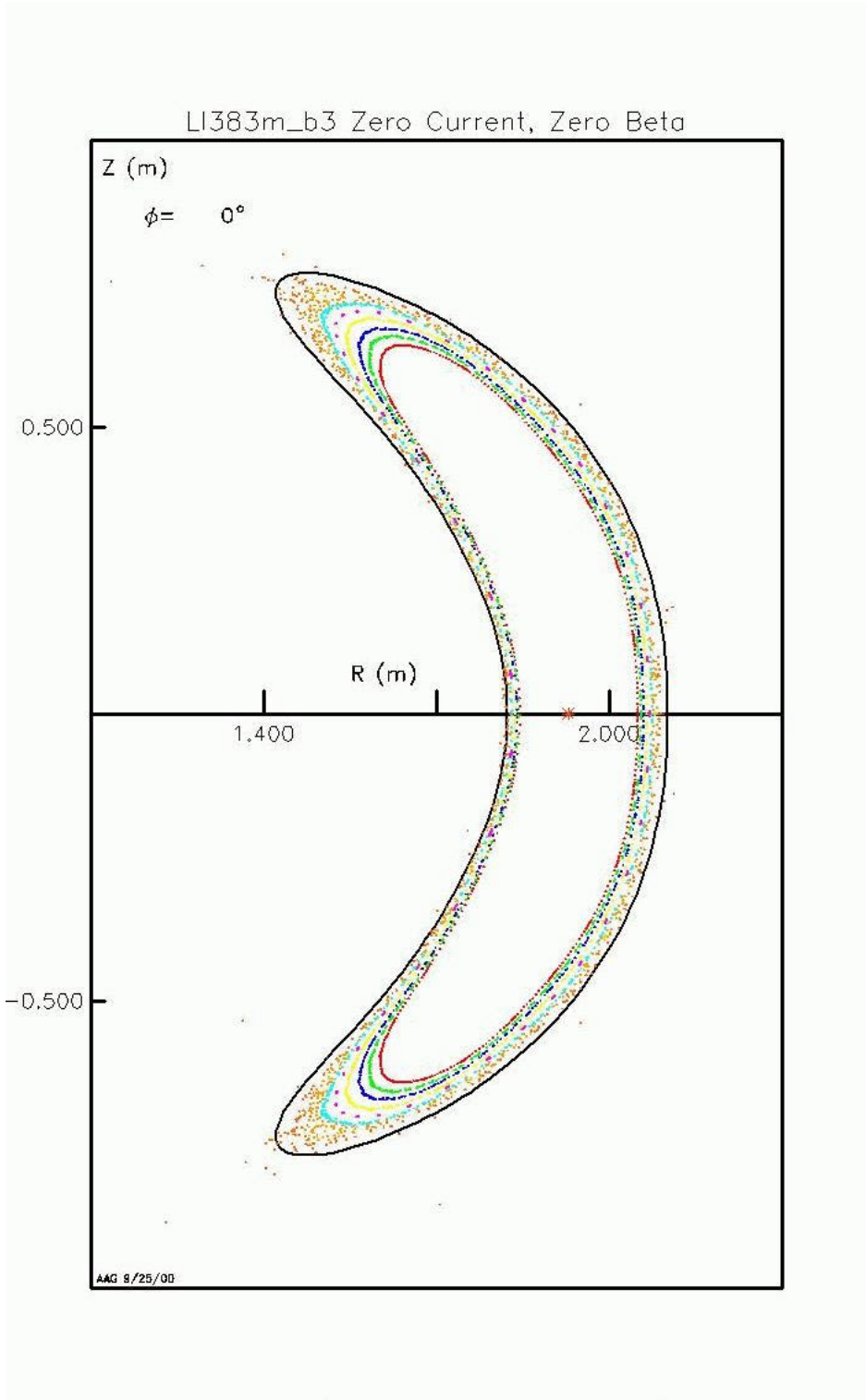
Single Field Line Started at R=2.120, Z=0, and VMEC LCMS (solid curve) LI383s_a3

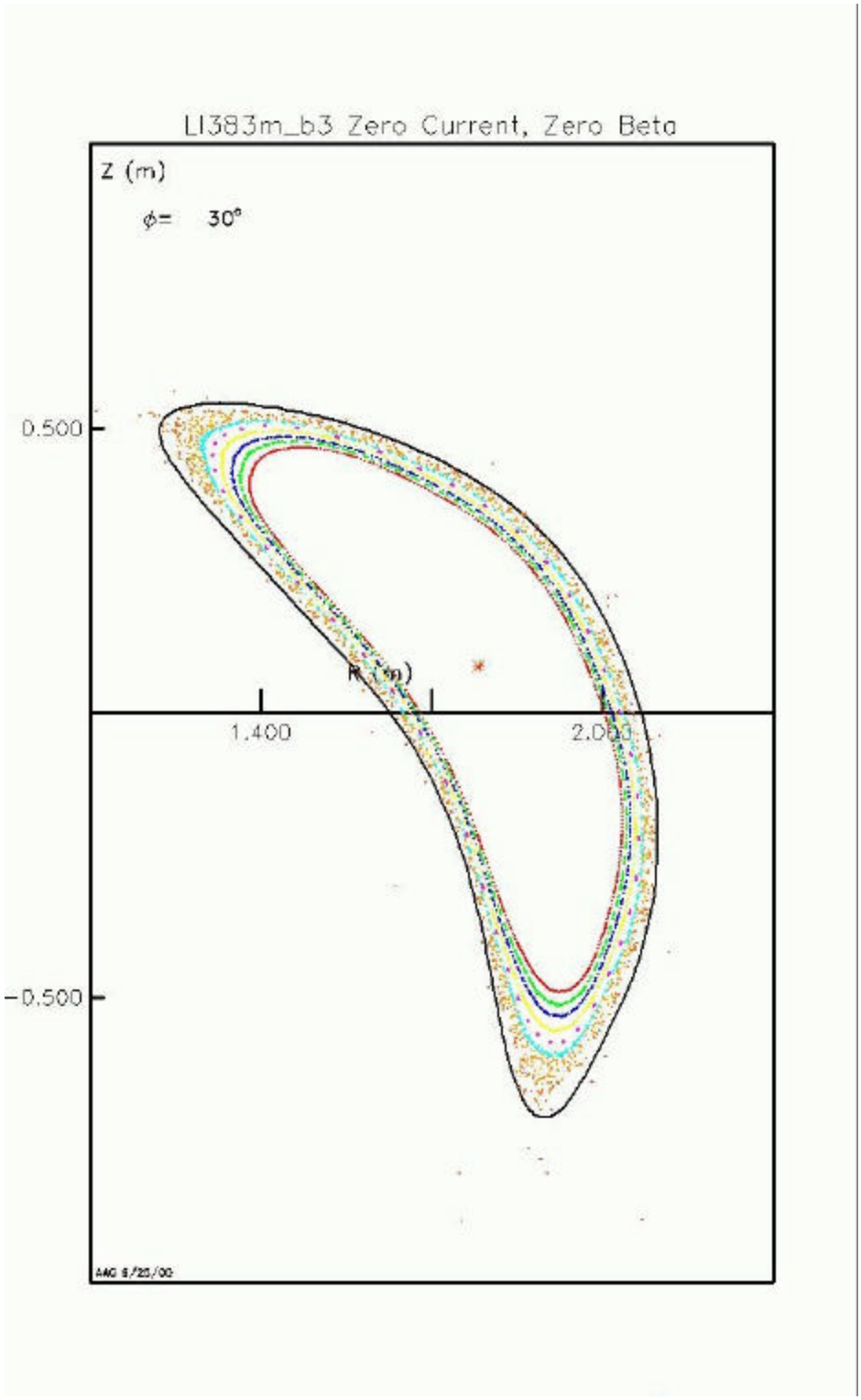


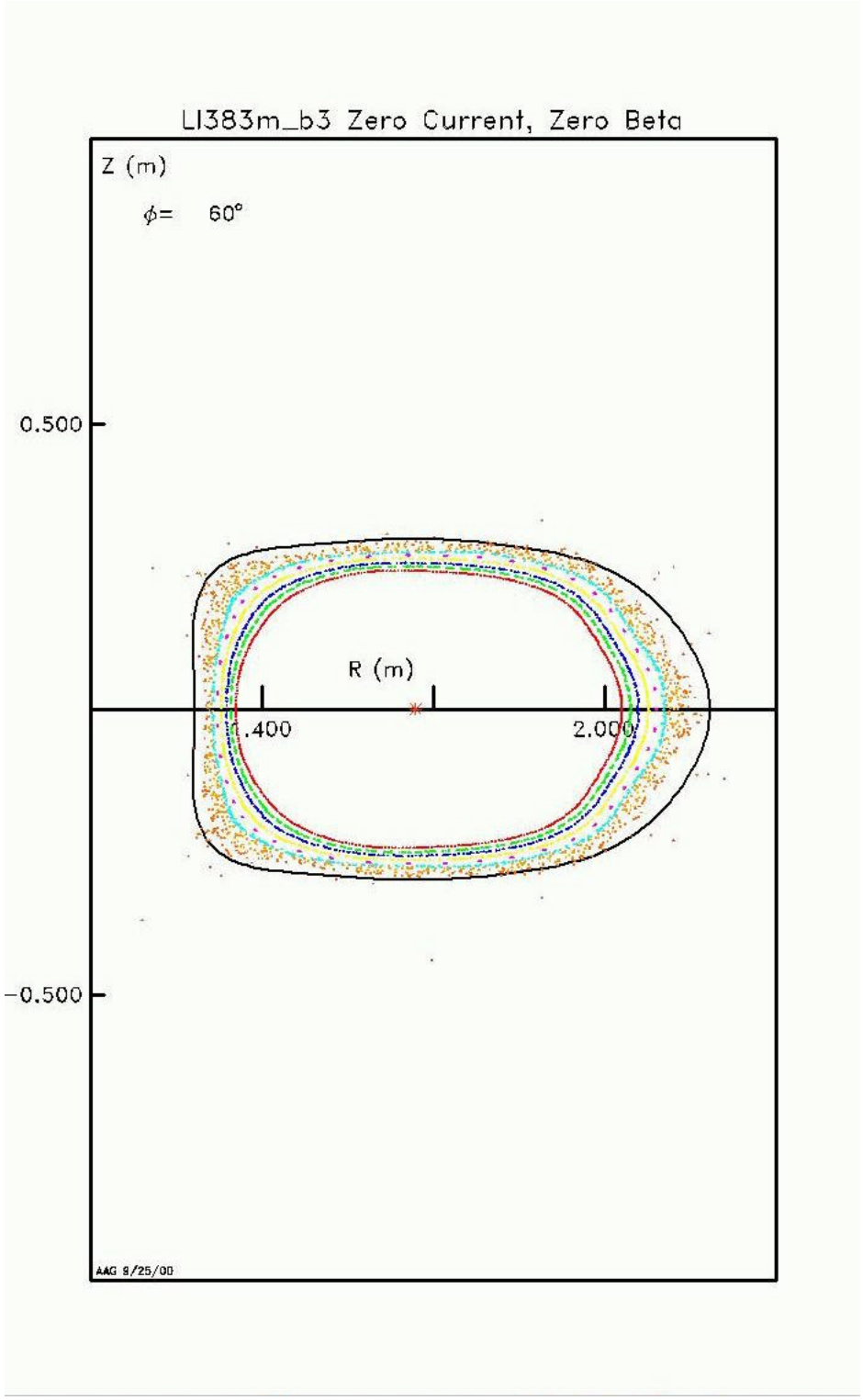
LI383m_b3: Modular Zero Current, Zero Beta 10-Field Line Tracing

Traced Line Numbe	Starting point R(m) [Z=0]	Iota-value of traced field line	LSS (MFBE)	Number of Toroidal Turns	Color
1	2.050	0.517085	72001	200	Red
2	2.055	0.520398	72001	200	Green
3	2.060	0.52383	72001	200	Blue
4	2.065	0.528743	72001	200	yellow
5	2.070	0.533273	72001	200	pink
6	2.075	0.538946	72001	200	lightblue
7	2.080	0.545456	72001	200	orange1 (yellow)
8	2.085	0.545947	72001	200	orange2
9	2.090	0.561838	52627	146	orange3
10	2.095	0.549382	2768	8	orange4 (red)



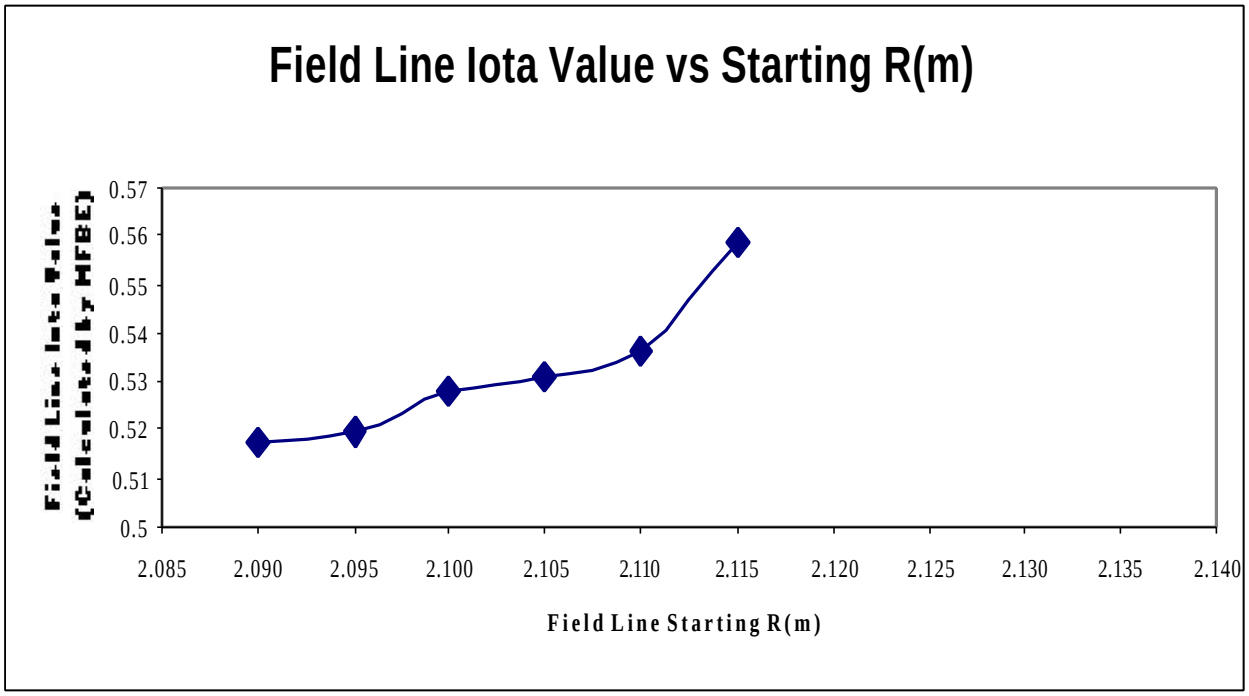

LI383m_b3 Zero Current, Zero Beta
Z (m)
ϕ= 0°
0.500
R (m)
1.400
2.000
−0.500
AAG 9/25/00

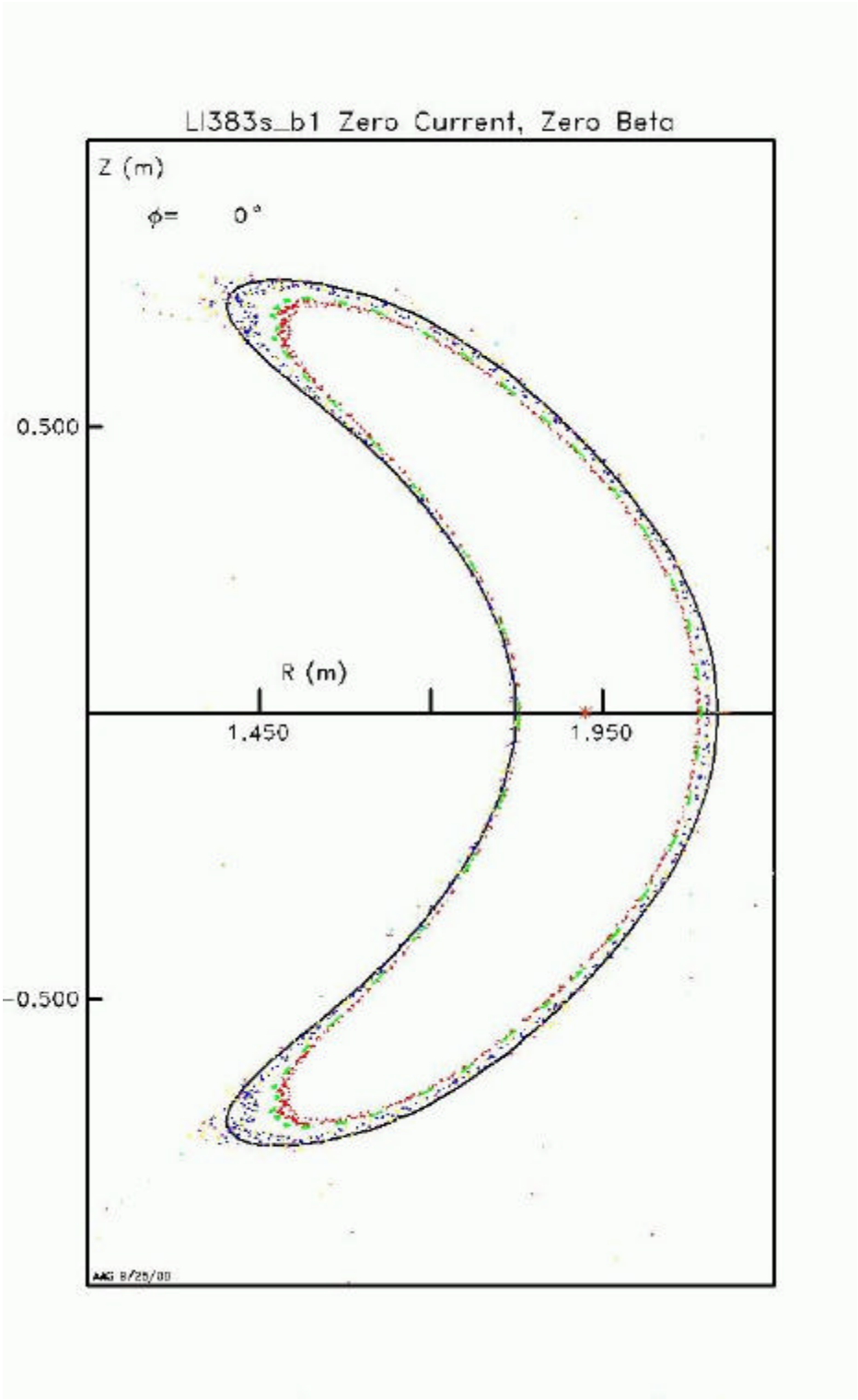

LI383m_b3 Zero Current, Zero Beta
Z (m)
φ= 30°
0.500
−0.500
R (m)
1.400
2.000
AAG 9/20/00

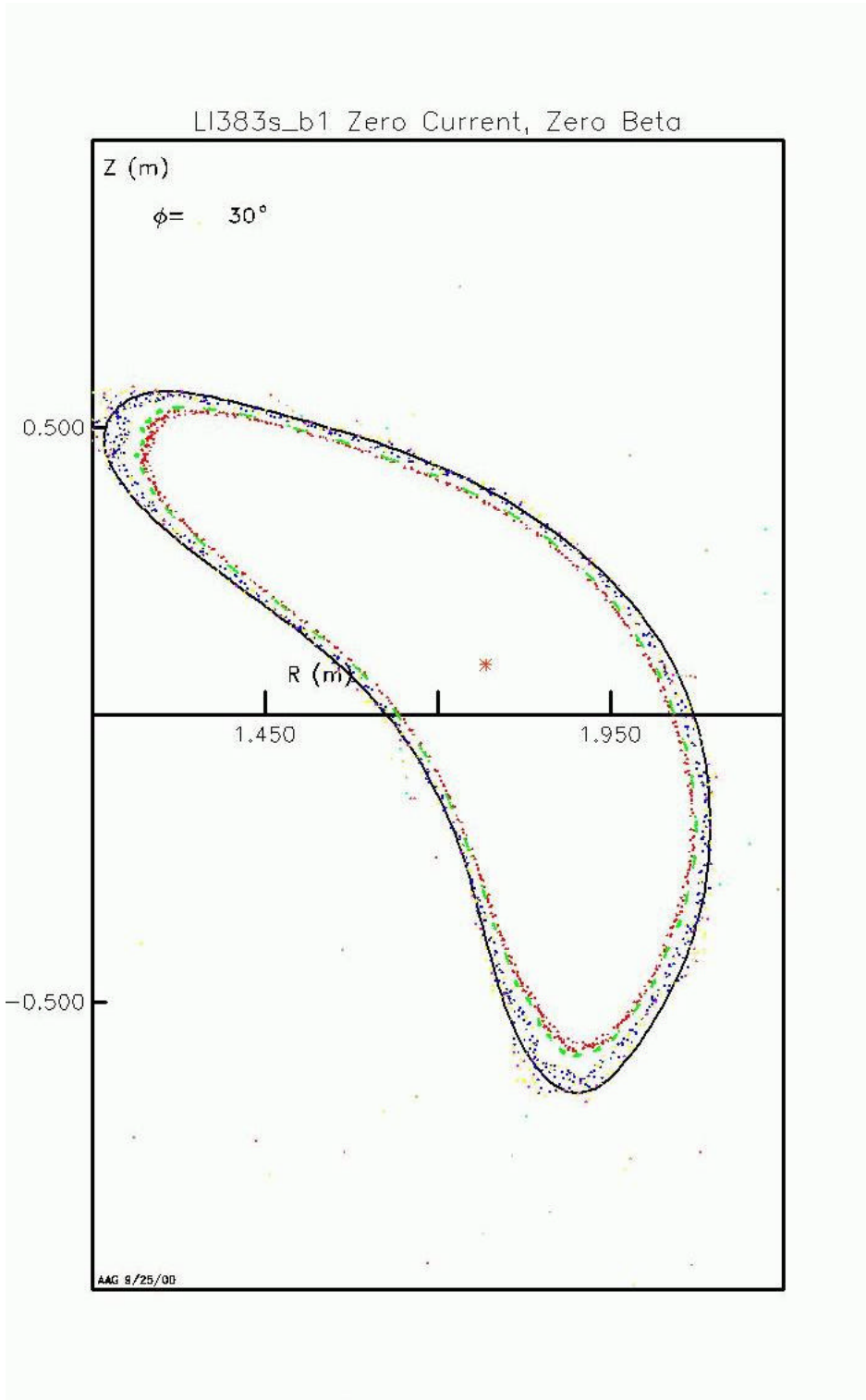

LI383m_b3 Zero Current, Zero Beta
Z (m)
ϕ= 60°
0.500
−0.500
R (m)
1.400
2.000
AAG 9/25/00

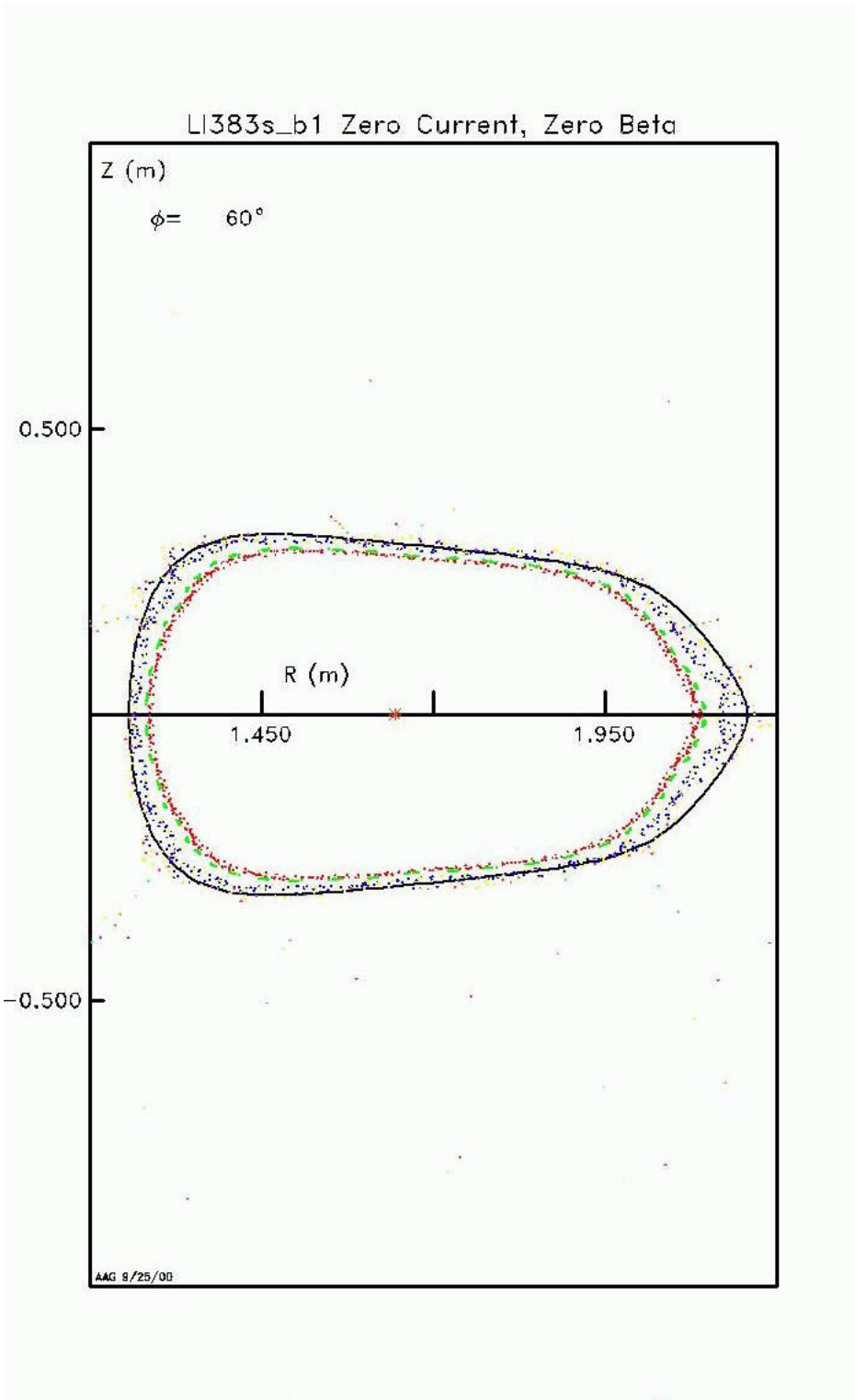
LI383s_b1: Saddle Coils Zero Current, Zero Beta 10-Field Line Tracing

Traced Line Numbe	Starting point R(m) [Z=0]	Iota-value of traced field line	LSS (MFBE)	Number of Toroidal Turns	Color
1	2.090	0.517503	72001	200	Red
2	2.095	0.51923	72001	200	Green
3	2.100	0.528032	72001	200	Blue
4	2.105	0.530876	46861	130	yellow
5	2.110	0.536438	10143	28	pink
6	2.115	0.559061	1626	5	lightblue
7	2.120		692	2	orange1 (yellow)
8	2.125	0.450843	1761	5	orange2
9	2.130		655	2	orange3
10	2.135	0.3092	1295	4	orange4 (red)



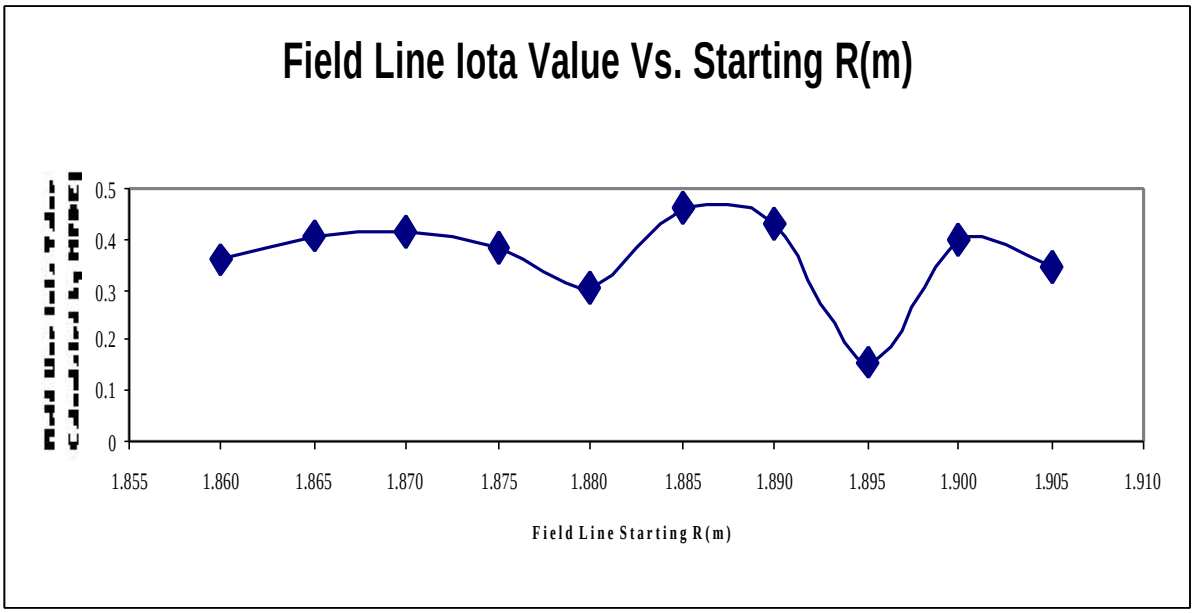

LI383s_b1 Zero Current, Zero Beta
Z (m)
φ= 0°
0.500
-0.500
R (m)
1.450
1.950
AAG 8/25/00

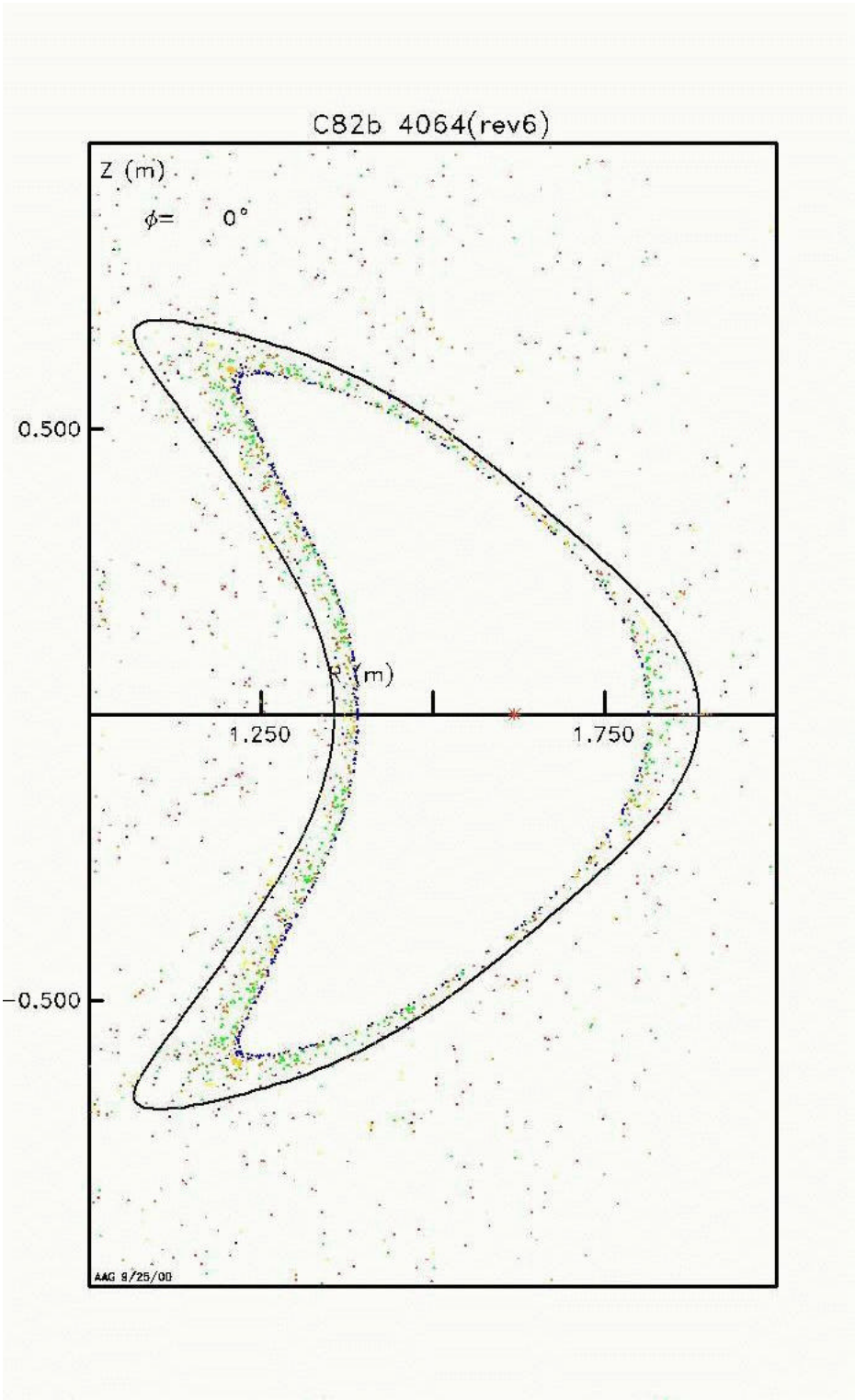

LI383s_b1 Zero Current, Zero Beta
Z (m)
ϕ= 30°
0.500
−0.500
R (m)
1.450
1.950
AAG 9/25/00

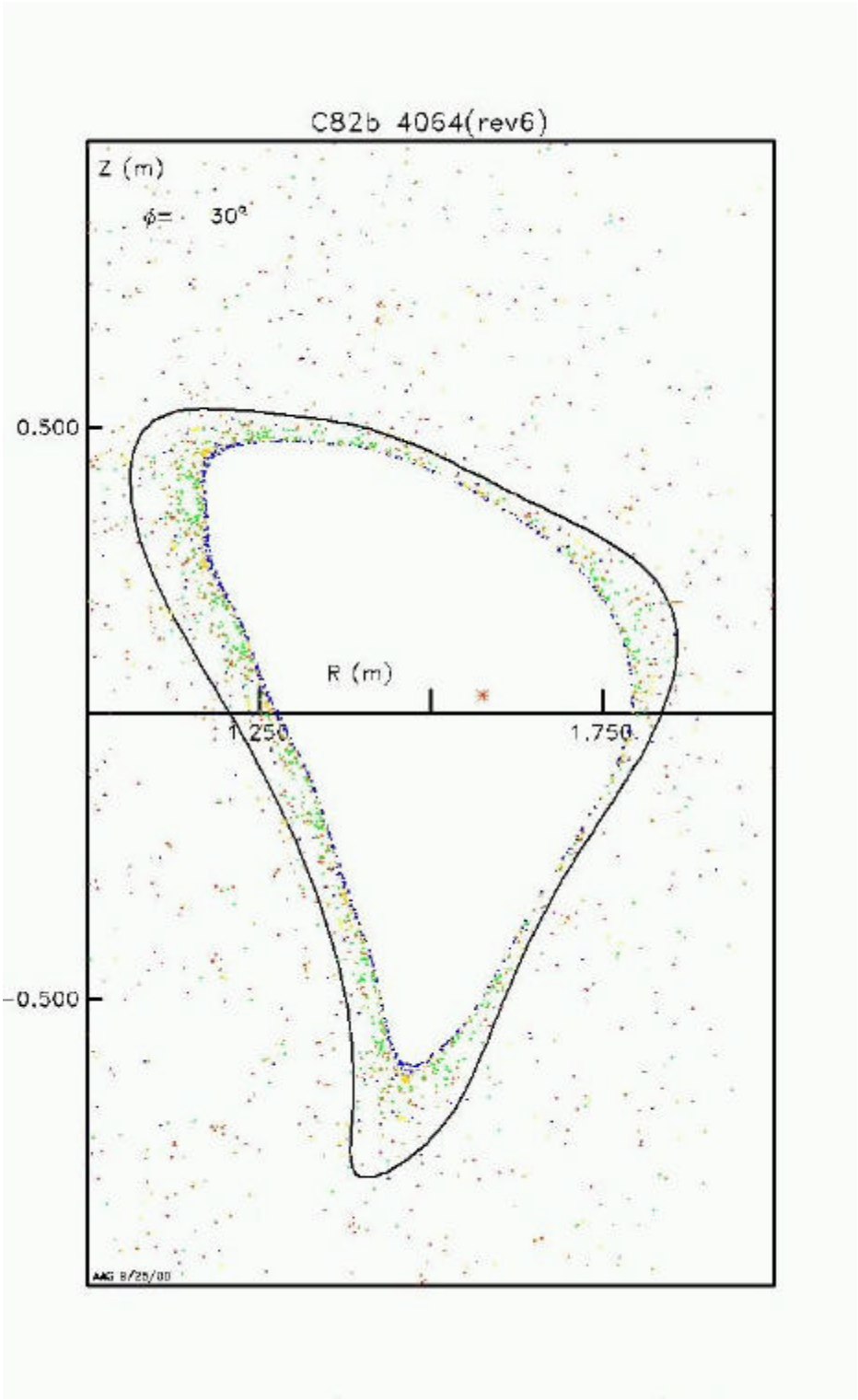

LI383s_b1 Zero Current, Zero Beta
Z (m)
ϕ= 60°
0.500
−0.500
R (m)
1.450
1.950
AAG 9/25/00

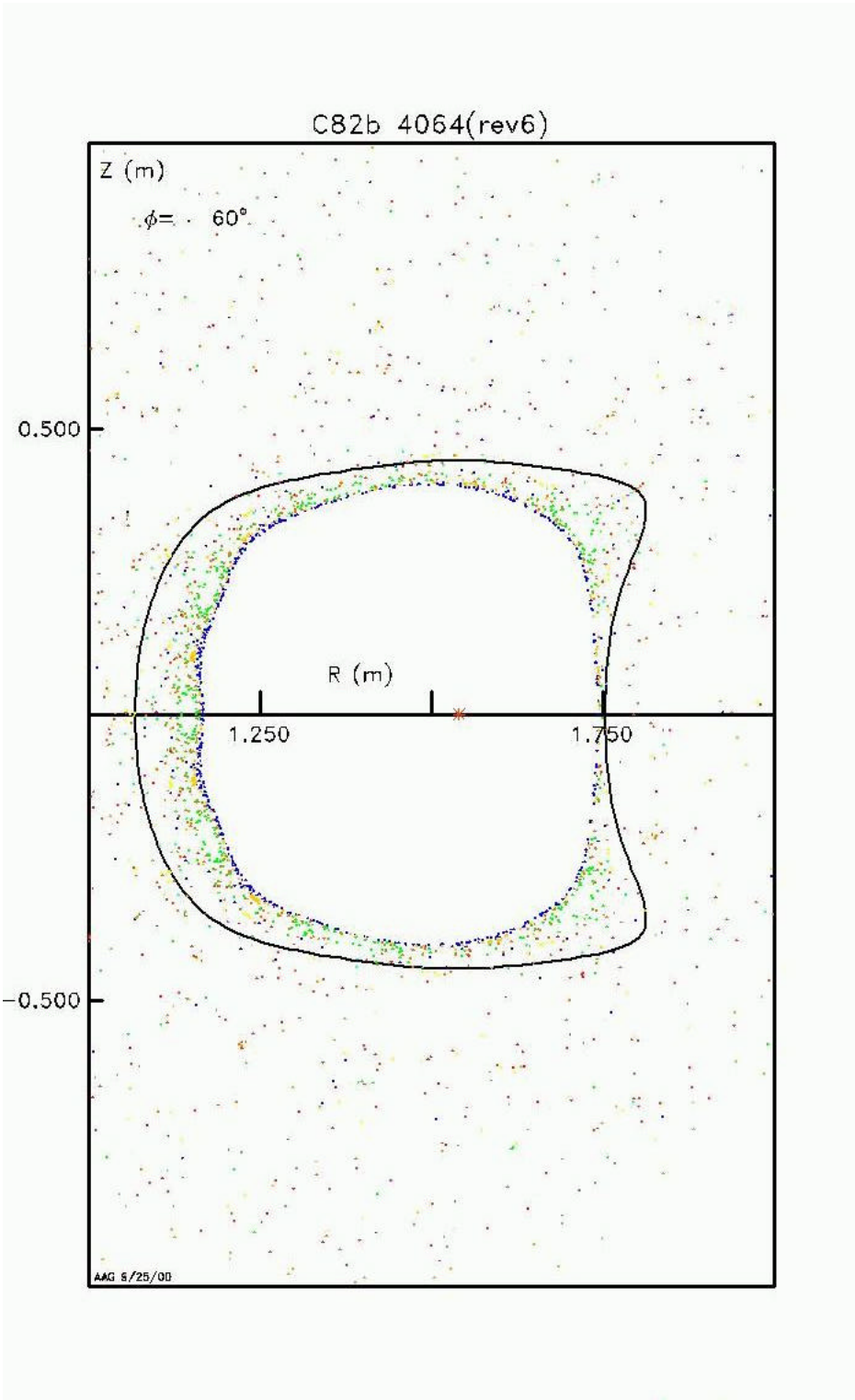
C82 (4064 Rev6)
10-Field Line Tracing

Traced Line Number	Starting point R(m) [Z=0]	Iota-value of traced field line	LSS (MFBE)	Number of Toroidal Turns	Color
1	1.860	0.3576	16137	45	Red
2	1.865	0.406292	72001	200	Green
3	1.870	0.410835	72001	200	Blue
4	1.875	0.380209	22317	62	yellow
5	1.880	0.302835	7800	22	pink
6	1.885	0.457802	3615	10	lightblue
7	1.890	0.426067	30915	86	orange1 (yellow)
8	1.895	0.154121	33510	93	orange2
9	1.900	0.402059	52595	146	orange3
10	1.905	0.343697	44557	124	orange4 (red)




C82b 4064(rev6)
Z (m)
φ= 0°
0.500
−0.500
R (m)
1.250
1.750
AAG 9/25/00


C82b 4064(rev6)
Z (m)
φ= 30°
0.500
-0.500
R (m)
1.250
1.750
AAG 8/25/00


C82b 4064(rev6)
Z (m)
ϕ= 60°
0.500
R (m)
1.250
1.750
−0.500
AAG 9/25/00

Conclusions

- In LI383, full beta, full current, there are five islands inside the plasma boundary, and five islands outside the plasma boundary. This means iota increases from the magnetic axis to the plasma boundary, and then decreases again. (iota=0.6=3/5 => 5 islands). MFBE uses grid points outside LCMS to compute magnetics just inside LCMS, and may indicate islands in this region not possible with VMEC magnetics alone.
- Comparing the patterns of the traced field lines and the shape of the plasma boundary suggests that the VMEC solution does not reproduce the real plasma boundary. Reasons include:
  - The extended five islands inside the plasma boundary. VMEC can not take into account these islands.
  - If the plasma boundary has a complicated structure, the mode numbers and the number of grid points used in VMEC (mu=9, mv=5, nu=24, nv=16) are not enough to reproduce this boundary.
  - The toroidal flux used by VMEC may be too large.
- The differences of the iota values are significant enough to account for differences in the observed field line tracing patterns. The calculated iota is correct when it is possible to trace the field line with enough toroidal turns. Field lines which leave in less than 10 toroidal turns are very ergodic and the rotational transform is no longer defined.