Comparison of magnetic field structures at the SOL for several standard NCSX equilibria using MFBE_2001

Arthur A. Grossman
UCSD
NCSX Physics Meeting 2 December 2003

MFBE_2001 vs MFBE

- E.Strumberger's MFBE_2001 has been entirely re-written to run on IBM parallel machines and interfaces with S.Hirshman's upgraded VMEC/NEMEC (asymmetric equilibria).
- Applied to the new NCSX equilibria, it appears to run about 4x faster than the previous MFBE calculations on the Cray parallel T3E machine.

MFBE_2001 has now been applied to these NCSX Equilibria:

m50_256.multi: multi-filament coils derived directly from the PIES healing algorithm with plasma at full beta/full current.

m50_e04: single-filament coil set obtained after smoothing out some kinks in the m50_256 coils with above LCMS and (almost) same plasma properties.

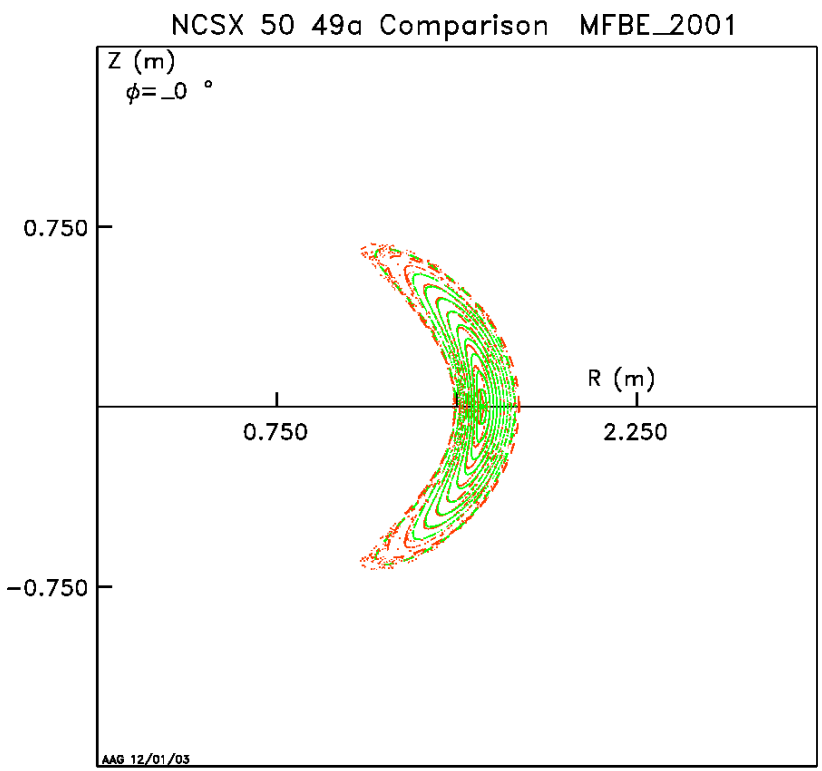
c08r00_s3.b.min : s3 state (beta = 4%, Ip = -179 kA, R*Bt = 2.38)

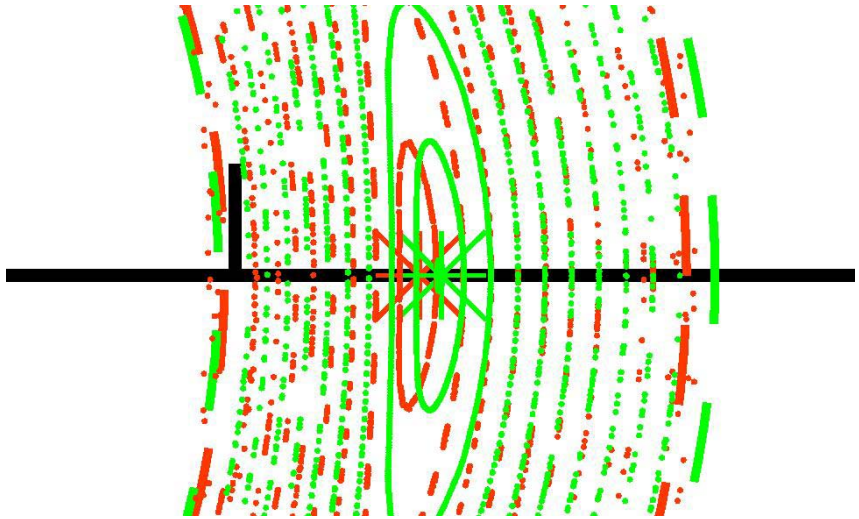
c08r00_b2.0.min: 2% beta at same current and field

c08r00_b0.0.min: 0% beta at Ip = -120 kA, full field

NZETA has been increased to 30, because of constraints on the number of processors allowed on IBM

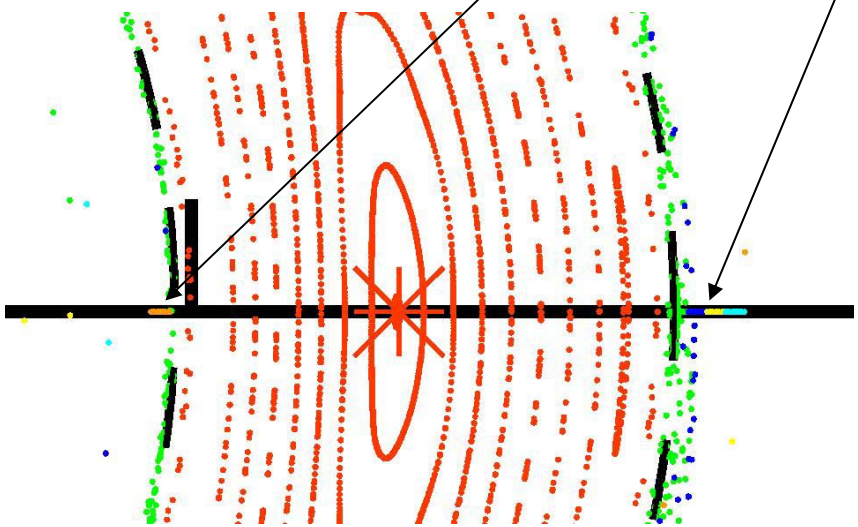
2% vs 4% Beta Core
2%- c08r00_b2.0.min - red
4%- c08r00_S3.b.min - green



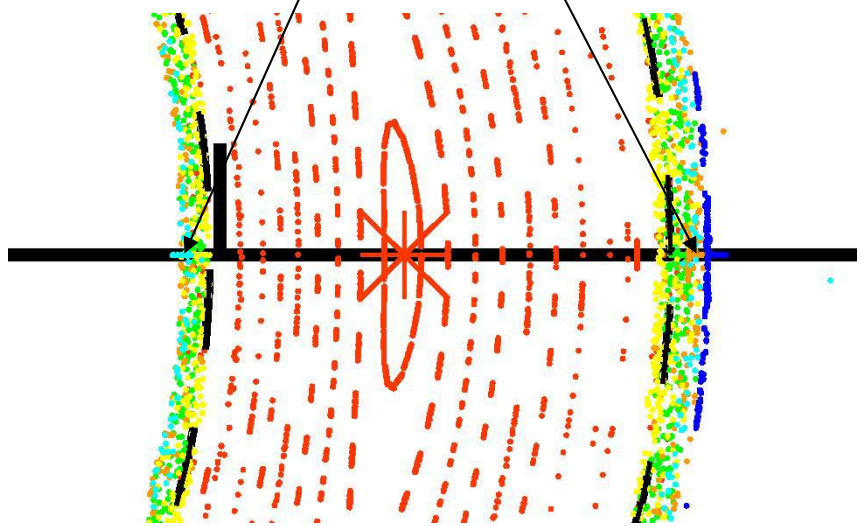


2% vs 4% Beta- SOL Starting Pts

Equidistant starting points 10 each to 1 cm with same color, all have z=0

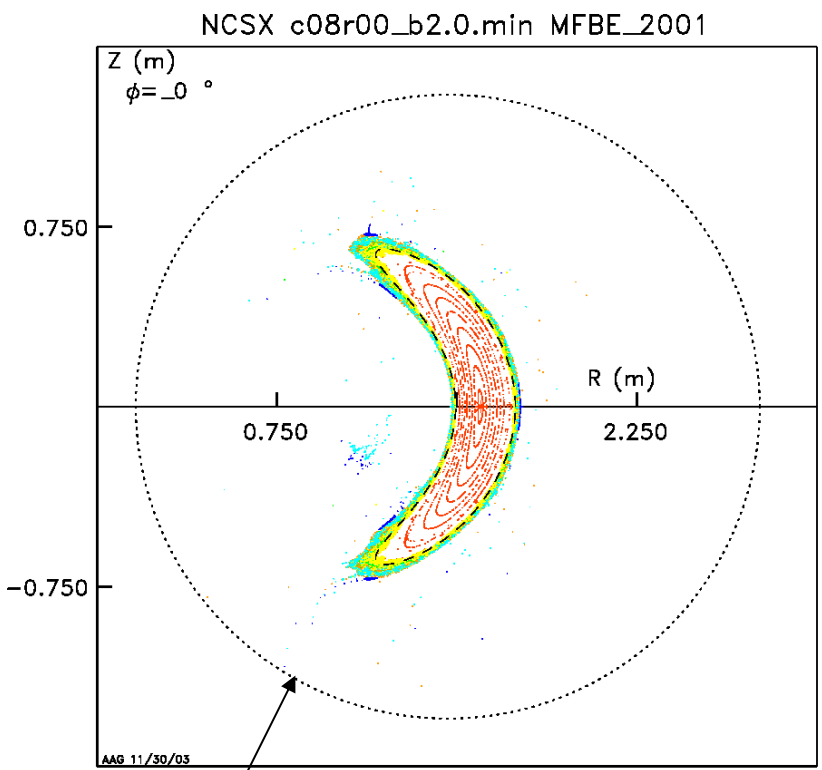


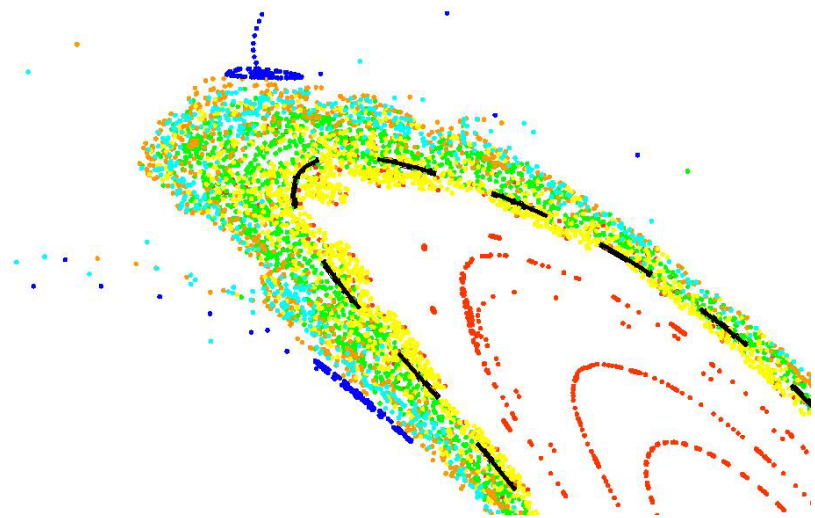
4%



2%

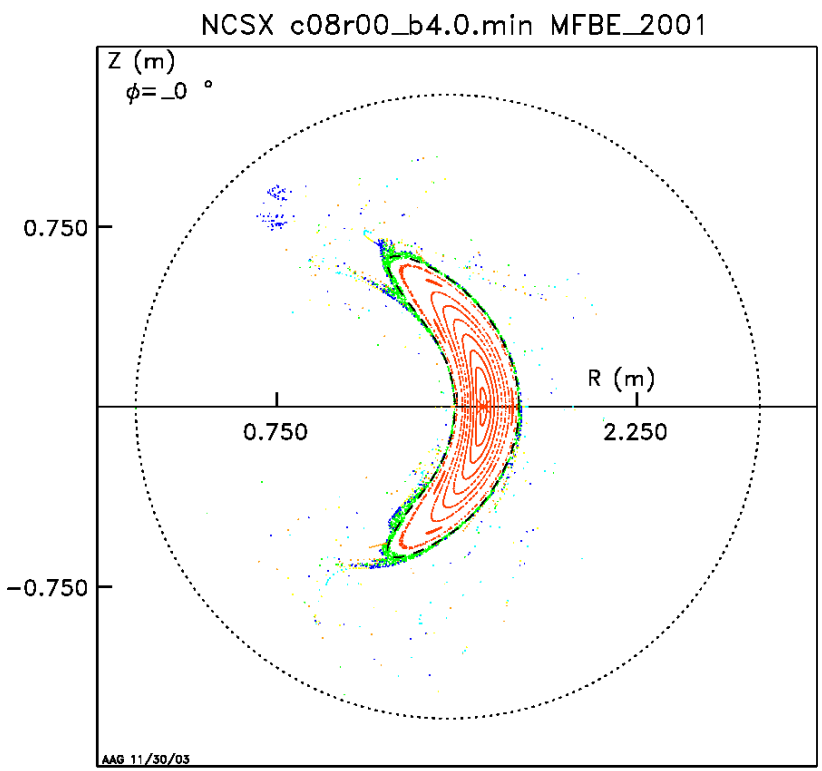
2% Beta –SOL Stochasticity plus an Island Structure c08r00_b2.0.min

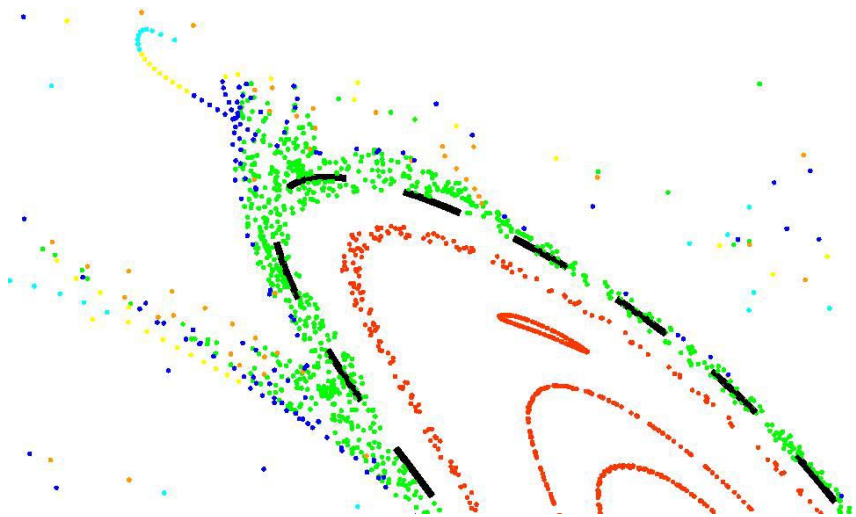




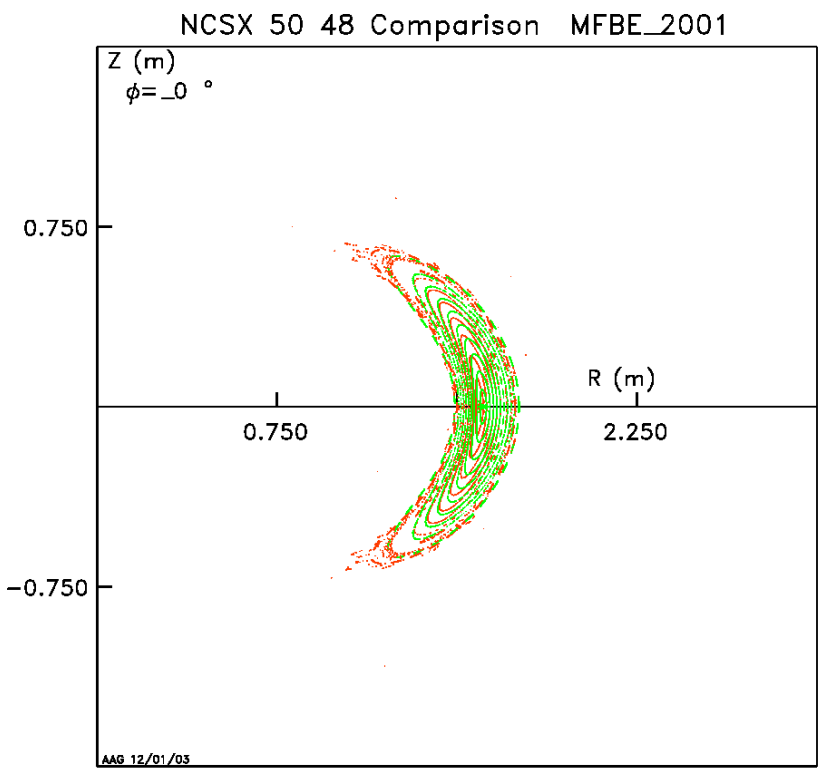
Initially an easily defined circular vacuum vessel within the rectangular grid is used, will be replaced by the NCSX vessel.

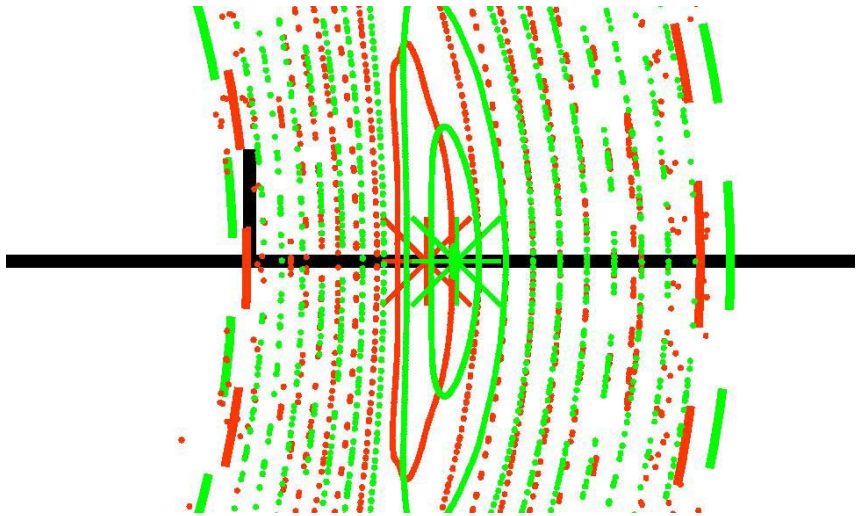
4% Beta-SOL Islands Not Seen c08r00_s3.b4.0min



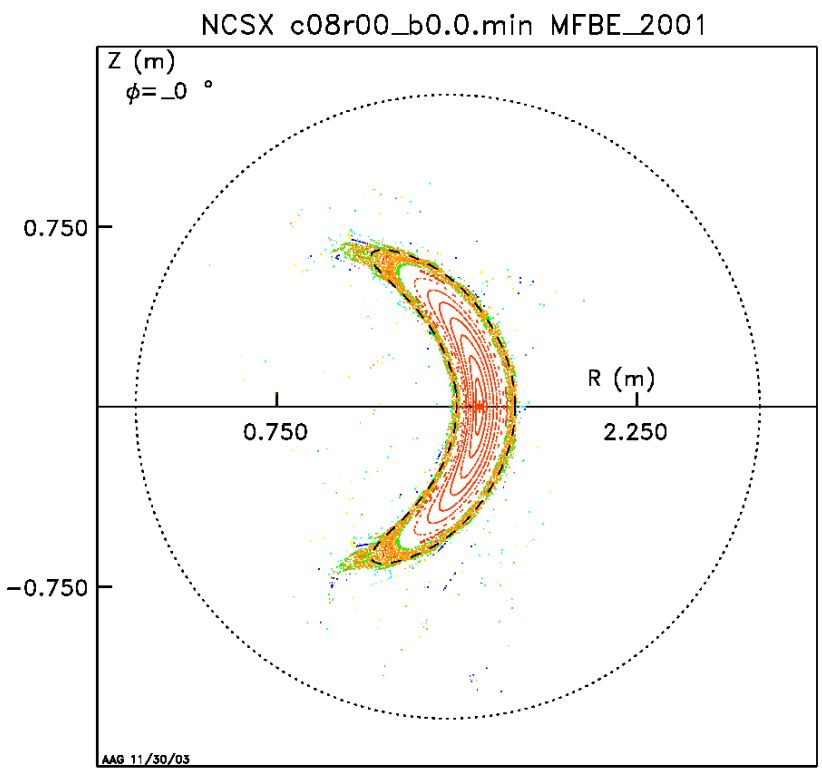


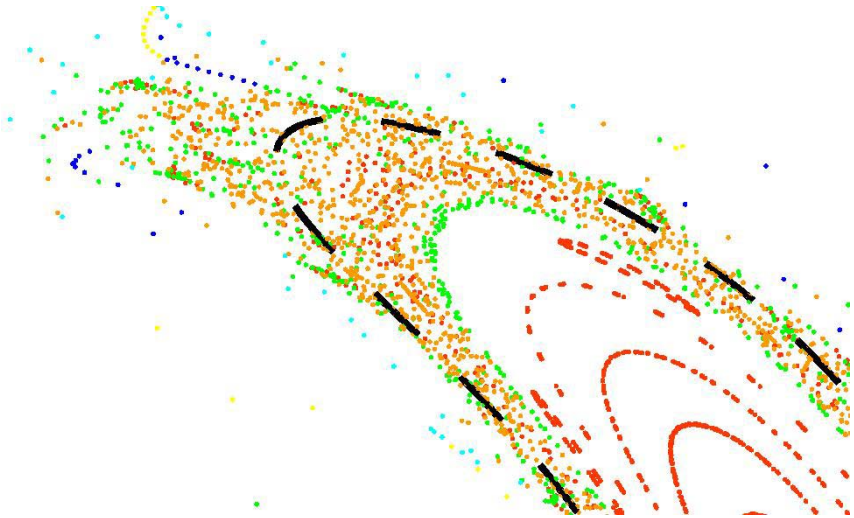
0% vs 4% Beta Core
0%- c08r00_b0.0.min - red
4%- c08r00_S3.b.min - green





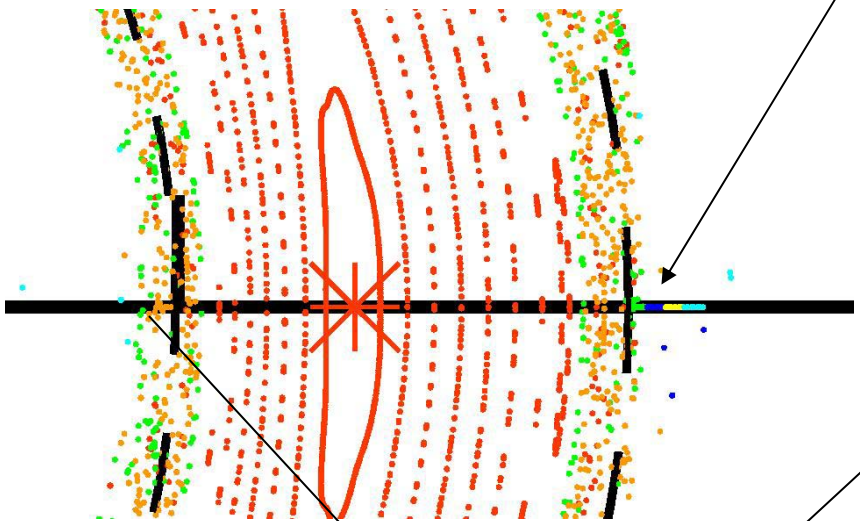
0% Beta –SOL Stochasticity c08r00_b0.0.min



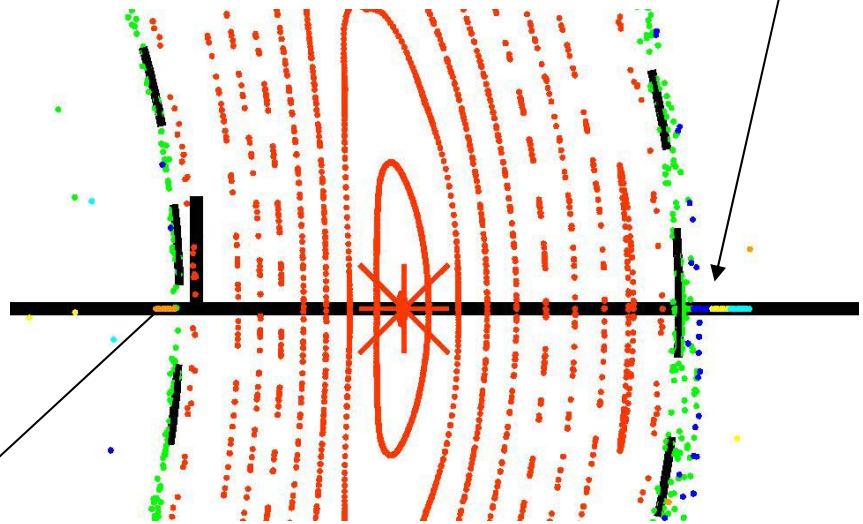


0% vs 4% Beta- SOL Starting Pts

Equidistant starting points 10 each to 1 cm with same color, all have z=0
In these two cases, the location and color coding of starting pts are the same



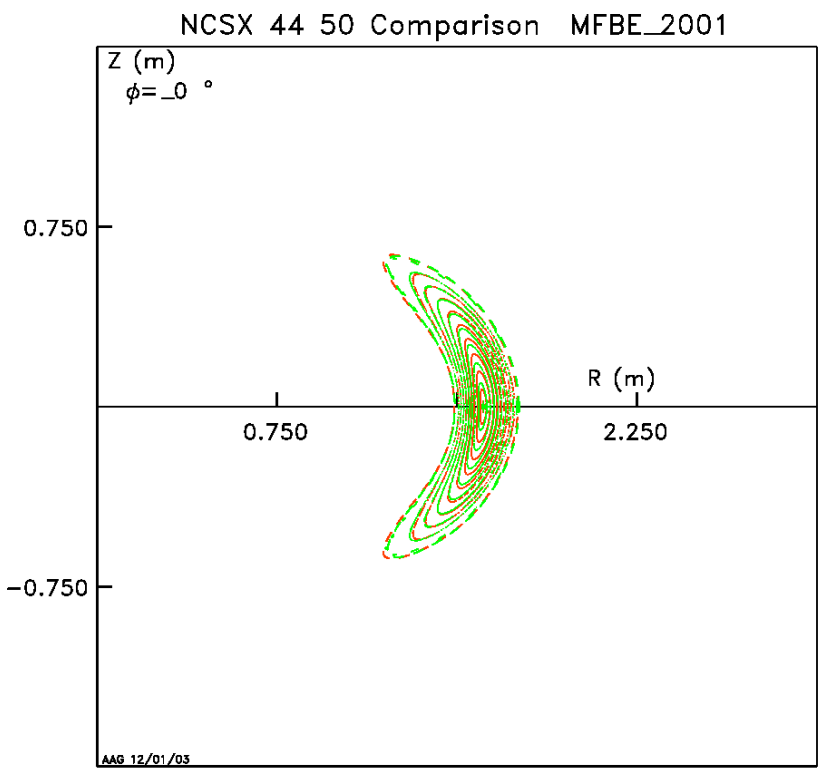
0%

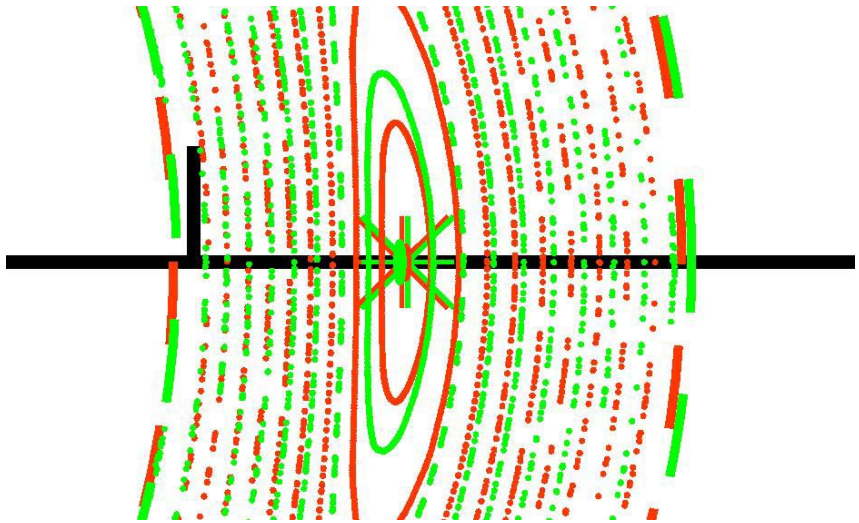


4%

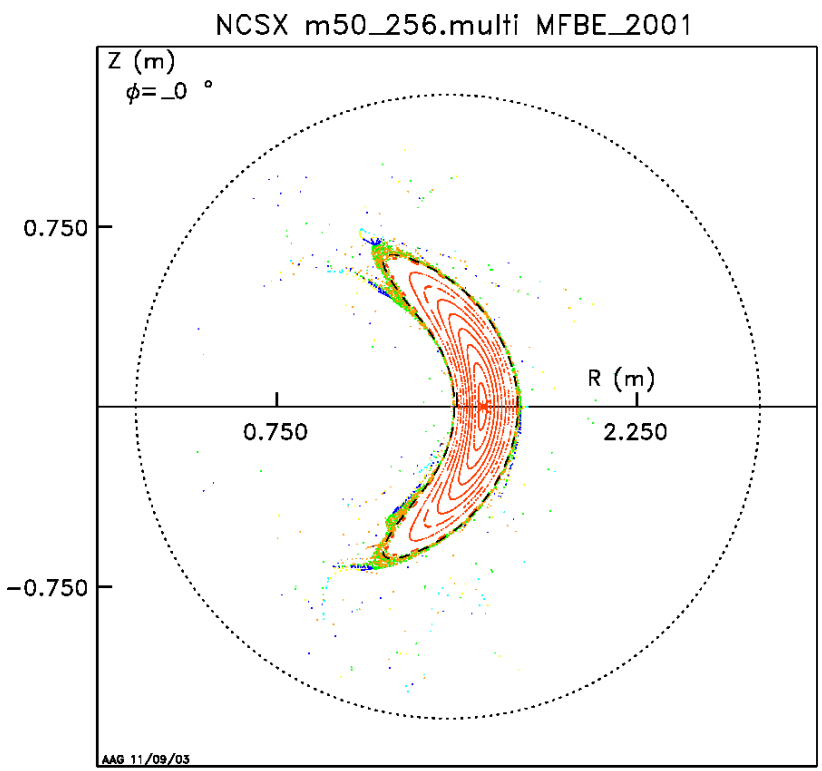
10 Inside starting points 1cm- gold

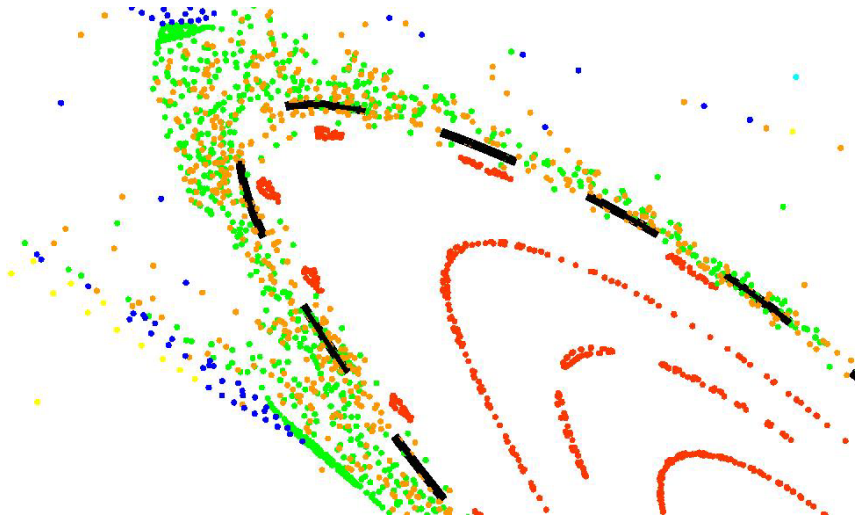
MultiFilament Base vs 4% Core
m50_256.multi - red
4%- c08r00_S3.b.min - green





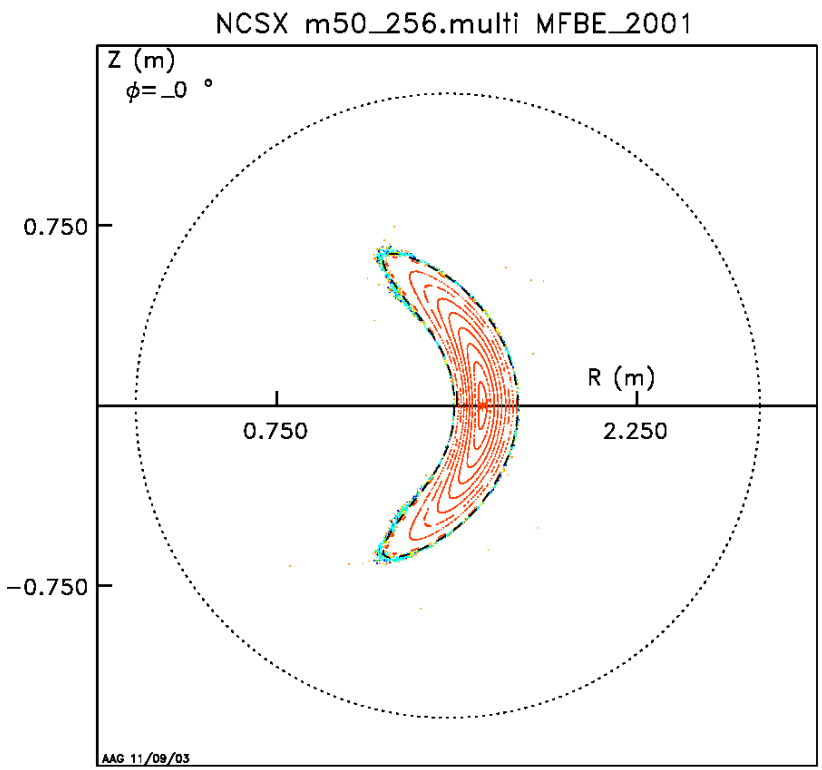
Multifilament Base –SOL Stochasticity with Island Remnants m50_256.multi

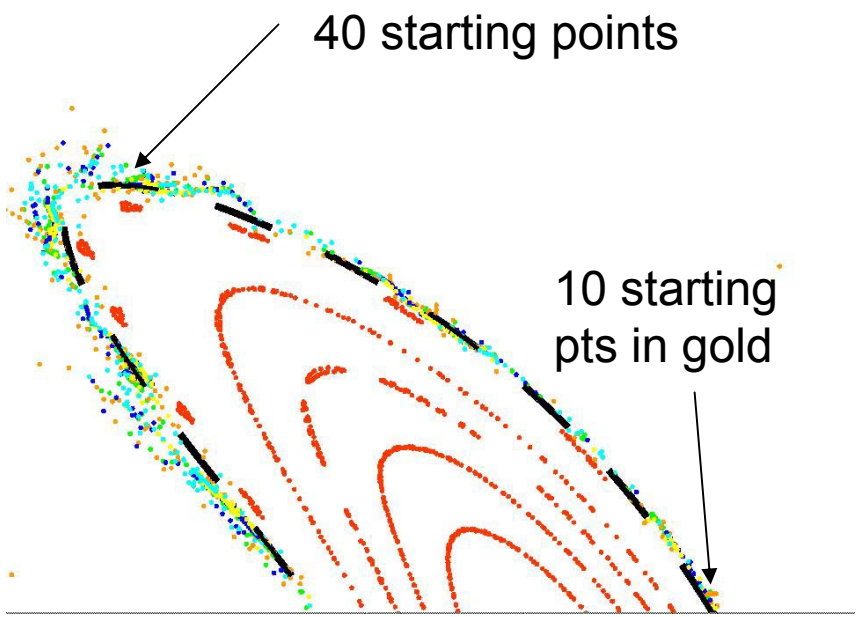




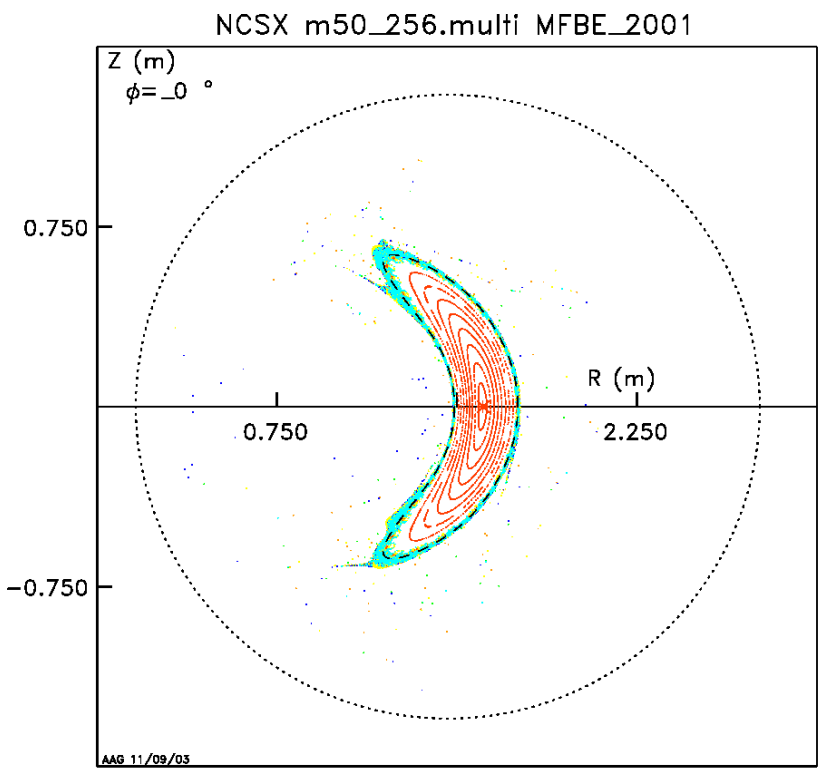
Starting points are on the midplane axis z=0

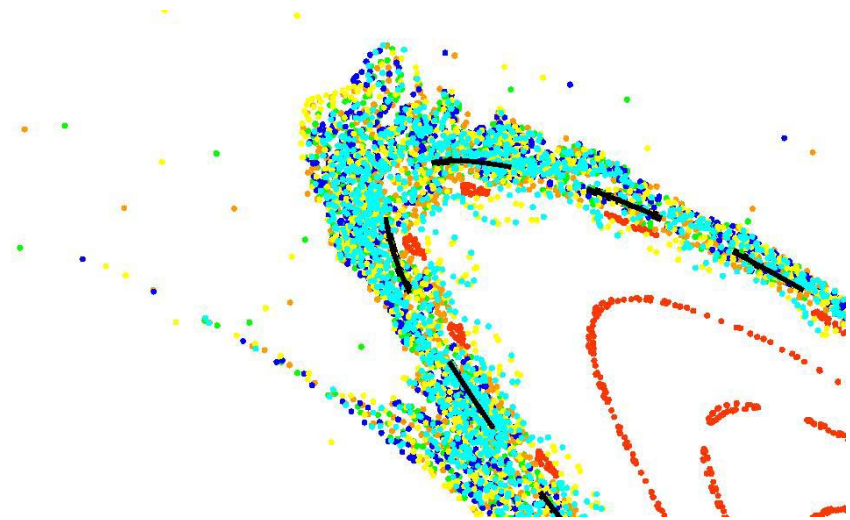
Off-Axis Starting Points- 20 turns





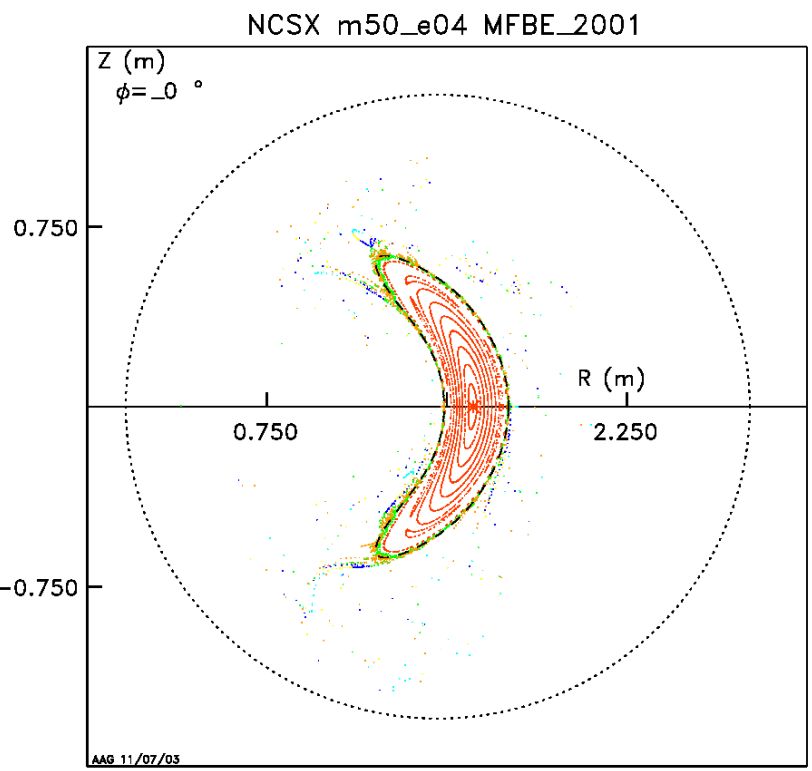
Off-Axis Starting Points- 200 Turns

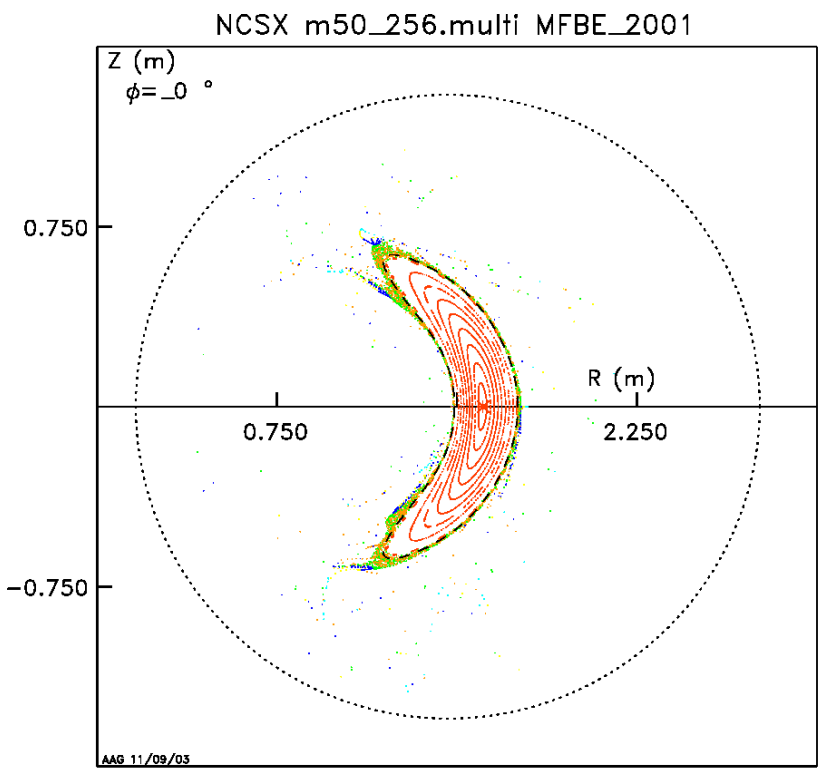




Result appears similar to on-axis starting pts shown 2 frames earlier.

Similar Results for m50_e04 and m50_256.multi





Conclusion

MFBE_2001 has been successfully modified to work with the upgraded NCSX VMEC2000 codes.

The magnetic structure in the SOL is more complicated than in the core. The magnetic structural changes in the SOL with beta are more than a radial SOL e-folding length, and need further study. The various versions of the standard case at the same full beta, full current show little variation in the magnetic structure.

Islands outside the LCMS appear to be associated with special starting points and can be masked by more numerous non-island forming starting points.