

3D MHD Equilibrium

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Introduction

3D MHD equilibrium is a basis of transport and stability calculations.

However, stellarator and Heliotron equilibria are very sophisticated!

=>No symmetry along the toroidal angle

Stochastization naturally appears.

=>Where is the plasma boundary in the stochastic layer?

The toroidal current is an important issue in W7-X and TJ-II

=>How much is the impact of the toroidal current on the magnetic topology?

RMP issues in tokamaks are studies of 3D physics! Stellarator and Heliotron community have many 3D tools for those studies. 3D MHD equilibrium is an important issue.

Many 3D codes are developed. However, discrepancy between those codes is found!

=>Necessity of benchmarking exercise

Talks

1. Introduction (Y. Suzuki)
2. benchmarking and validation initiative for 3D equilibrium calculations for the DIII-D tokamak (A. Reiman, PPPL)
3. 3D equilibrium calculation of HINT2 code for the DIII-D tokamak (Y. Suzuki)
4. Discussion (all)

Discussions

1. Plan of benchmarking exercise for DIII-D
2. Effects of the toroidal current to the magnetic topology
3. How to show our collaboration?
ISHW, EPS, APS, IAEA?
4. Other configurations
RFP,.....
5. Reconstruction

Benchmarking exercise for DIII-D

1. What is next step?
2. Where is goal?
3. Differences between 3D MHD equilibrium codes and perturbed equilibrium code.
4. How to compare with nonlinear simulations?

Current profiles, extended MHD code,

Specific sensible information for benchmarking ? Diagnostics ?

Beta increase

Effects of the toroidal current to the magnetic topology

In low magnetic shear configuration, the toroidal current makes big impact!

In W7-X, the toroidal current strongly affects the edge magnetic topology!

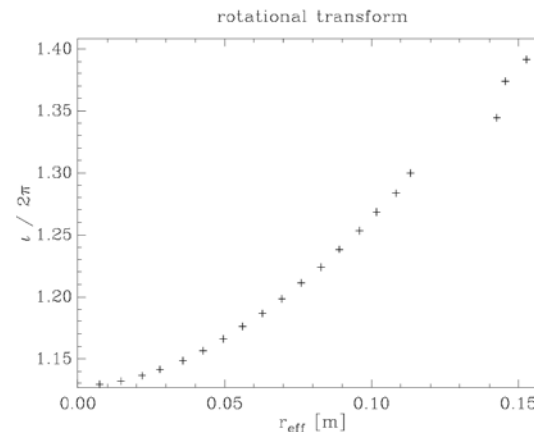
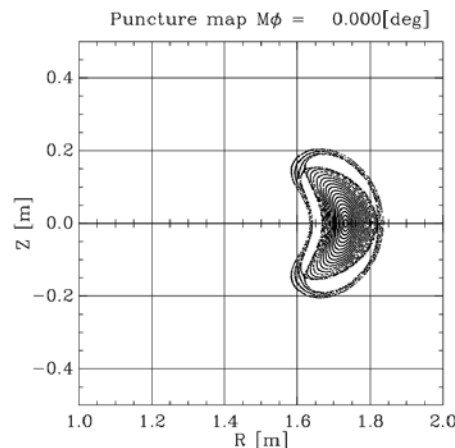
=> VMEC/EXTENDER studies on going (J. Geiger, IPP)

=> HINT2 calculations will be studied (J. Geiger and Y. Suzuki)

In TJ-II, significant change of the magnetic topology is expected for the iota scan experiments.

=> VMEC studies are done. HINT2 calculations are started. H-J should be started.

=> V&V are important for W7-X experiments



Publications

- A. Reiman submitted papers of benchmarking exercise for DIII-D to next EPS and IAEA.
- J. Geiger will show HINT2 calculations for W7-X in next EPS (?).

Developing new collaboration

- Helical core and 3D displacement for tokamaks (Y. Suzuki)
- RMP studies in EAST and KSTAR (Y. Suzuki)

Other configuration

- VMEC well works in RFP (J. Hanson,...)

Reconstruction

?

HINT2 simulation for a DIII-D shot

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Up-down asymmetric calculation by VMEC

PF coils of DIII-D do not have the stellarator symmetry.

=>It is impossible for the up-down symmetric calculation of HINT2.

=>Up-down asymmetric calculation is performed to check differences.

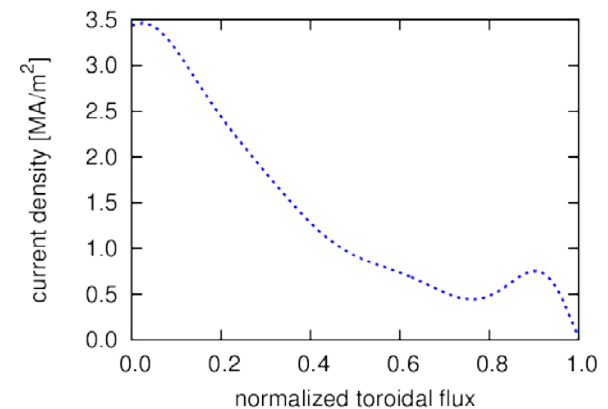
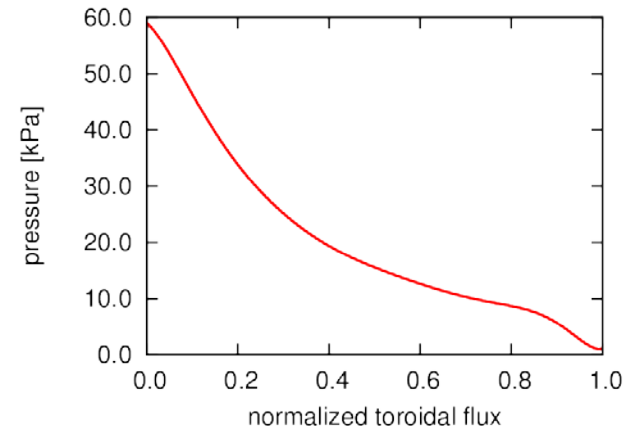
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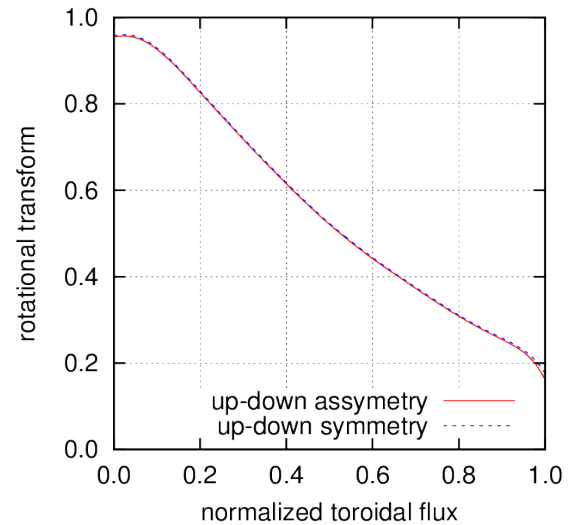
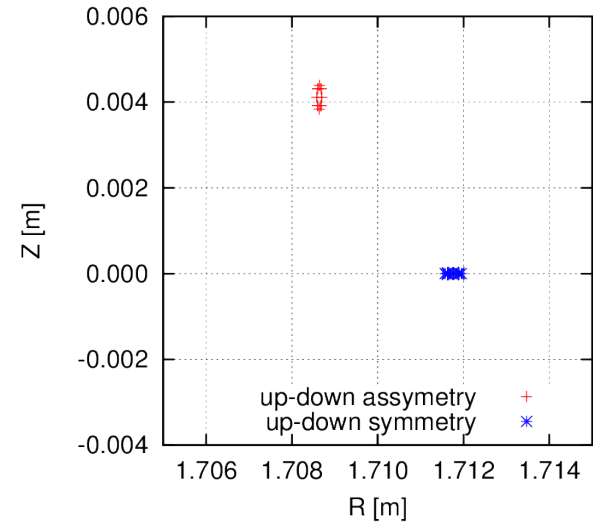
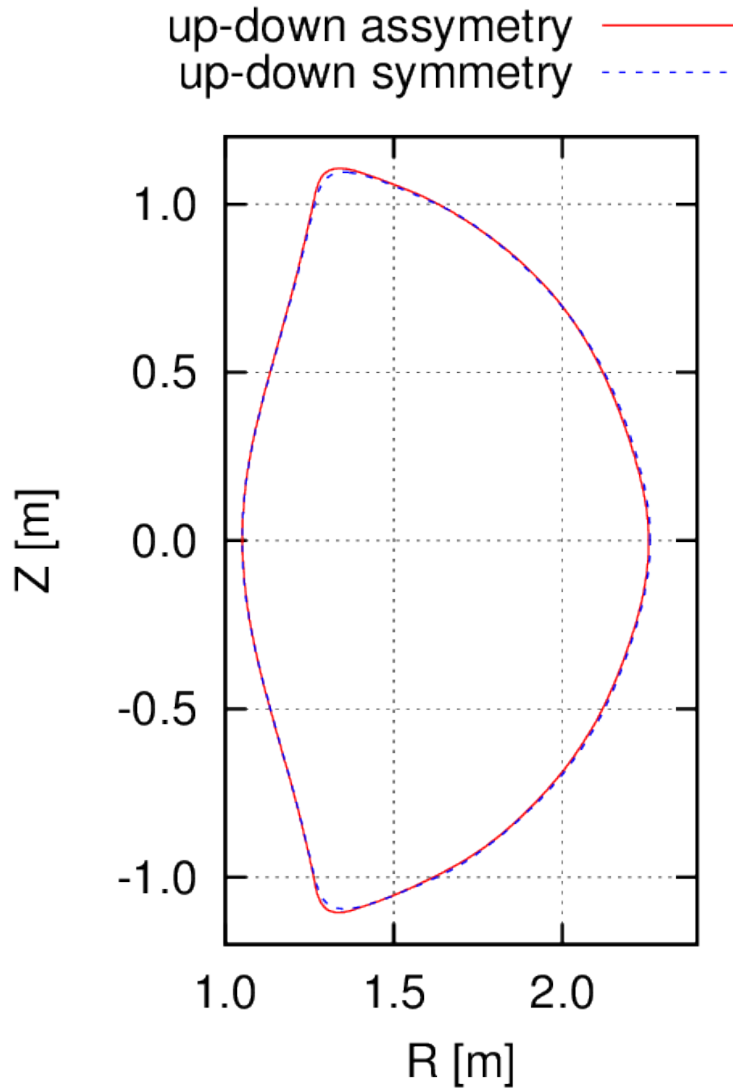
Double null configuration

n=3 perturbed field by I-coils only

No C-coil currents



Up-down asymmetric calculation by VMEC



Summaries of first HINT2 calculation

Magnetic island are opened on rational surfaces. Edge magnetic field becomes stochastic. Checking the initial field is important. HINT2 needs closed surfaces to relaxed the pressure. => This calculation was used to the vacuum solution.

