

An Update on Divertor Plate Geometry, Thermal and Alpha Heat Load Analysis

T.K. Mau (UCSD)

X.R. Wang (UCSD)

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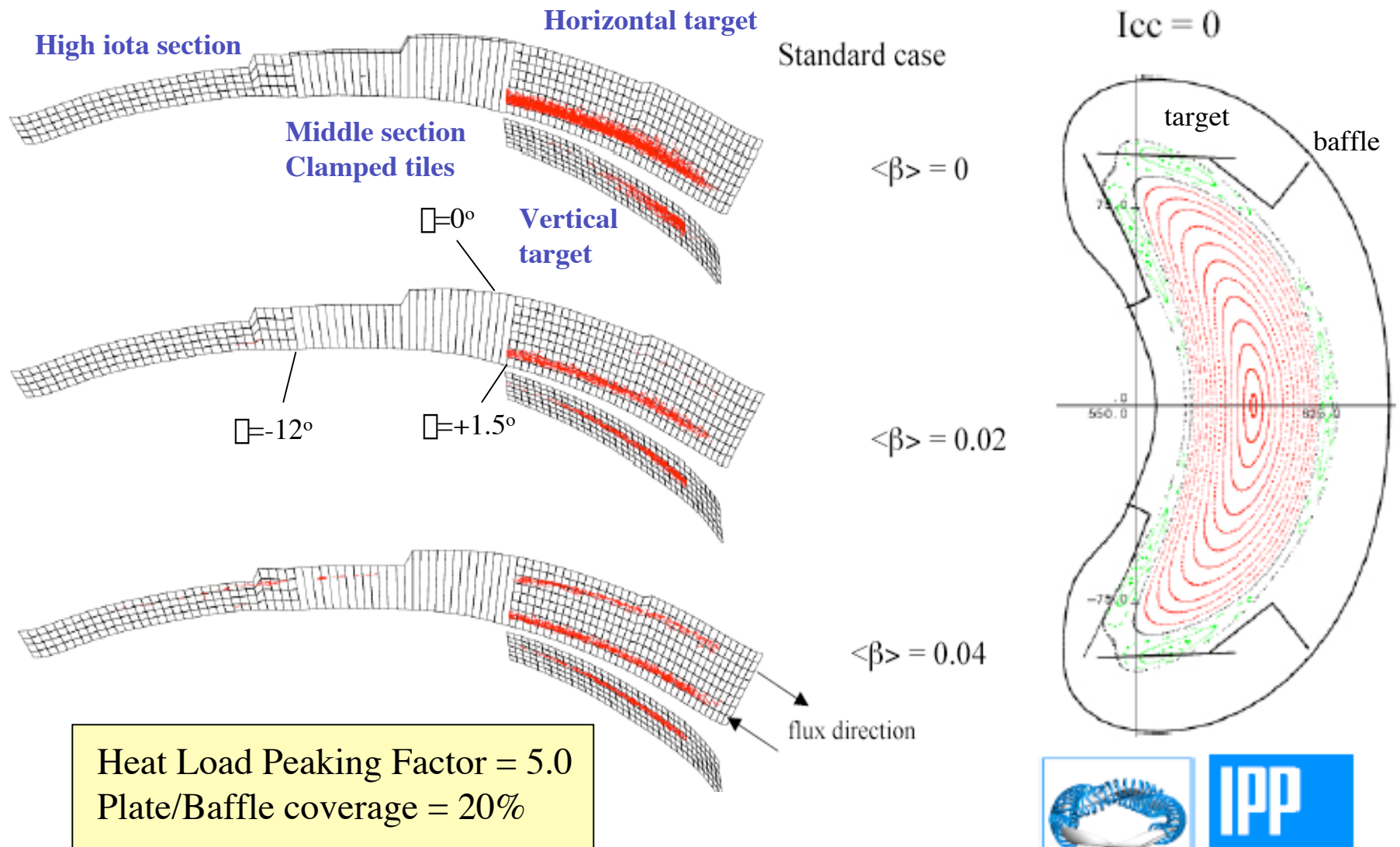
OUTLINE

- Divertor Plate Geometry modeled on W7-X and HSR
- Status of Divertor Heat Load Analysis and Plans
- Plans for Alpha Heat Load Analysis on PFCs

Status of CS Configurations for Divertor Study

- NCSX-ARE ($R = 7$ m):
 - Divertor plate geometry is based on this configuration and scaled to 7.75 m case.
- NCSX-KZD ($R = 8.25$ m):
 - Was able to generate closed flux surfaces inside LCMS with field line tracing, and produce ergodic region near LCMS.
 - Divertor heat load study is based on this configuration.

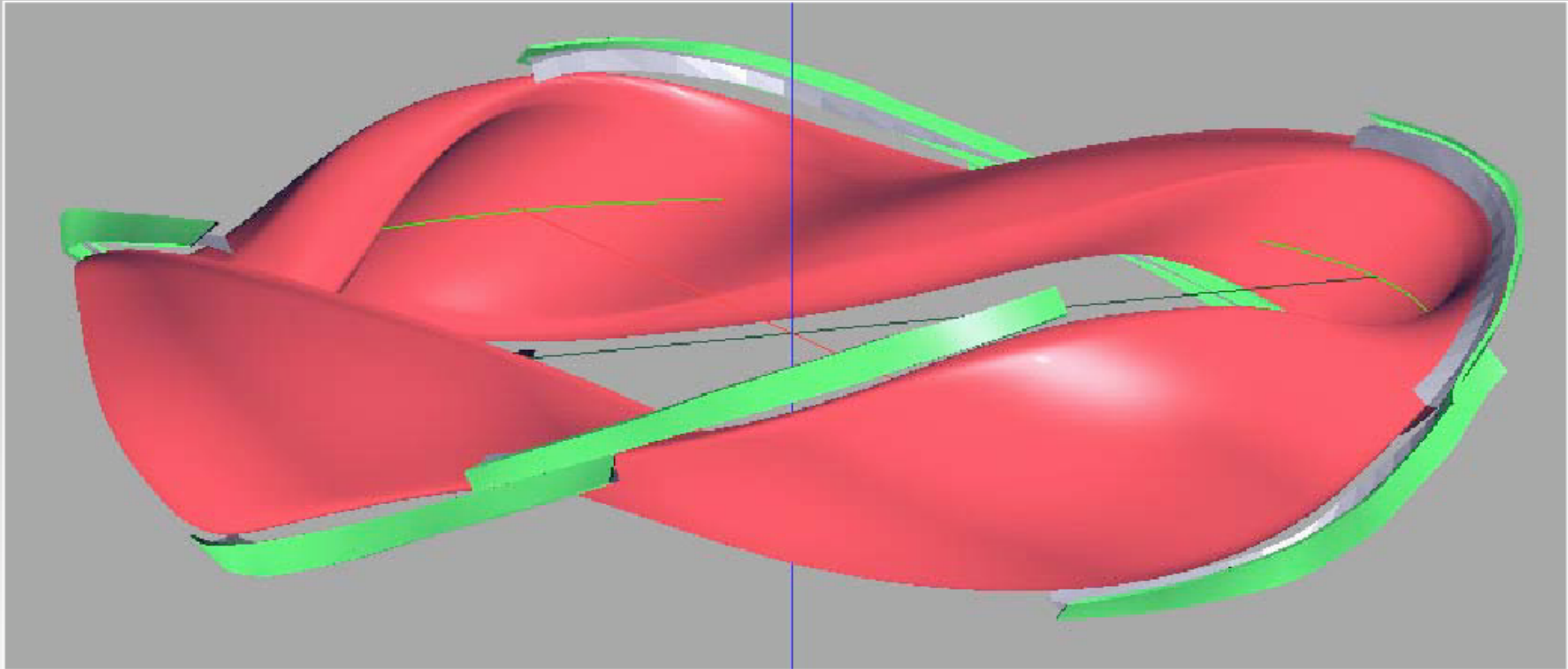
Target/Baffle Configuration and Footprints for W7-X Divertor



From Kißlinger via Lyon



HSR4/18 Divertor



8 Target plates

Length 15 m

Width 1m

Segment length 2 m

Wetted area 40 m²

Plasma surface area = 2700 m²

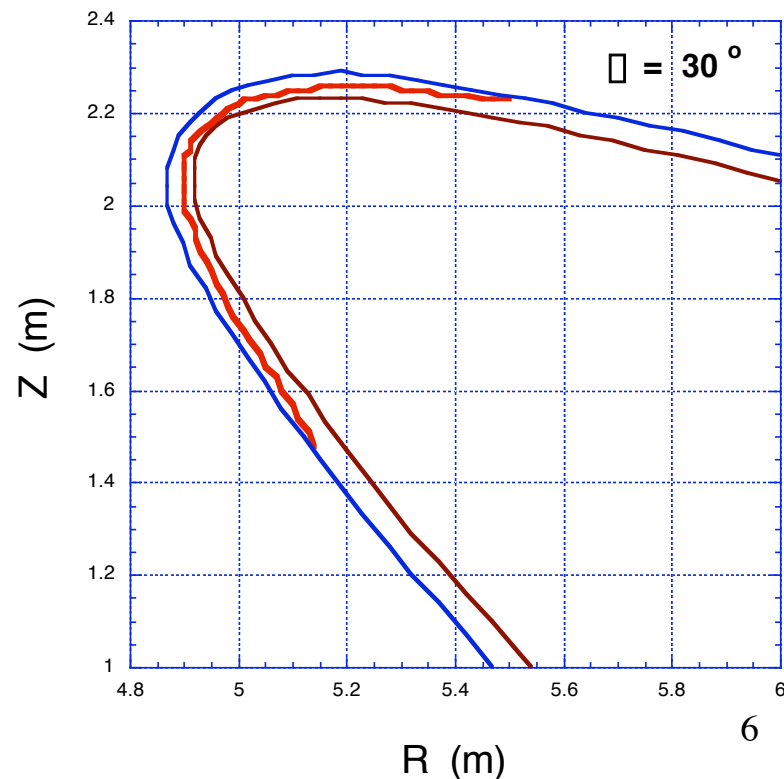
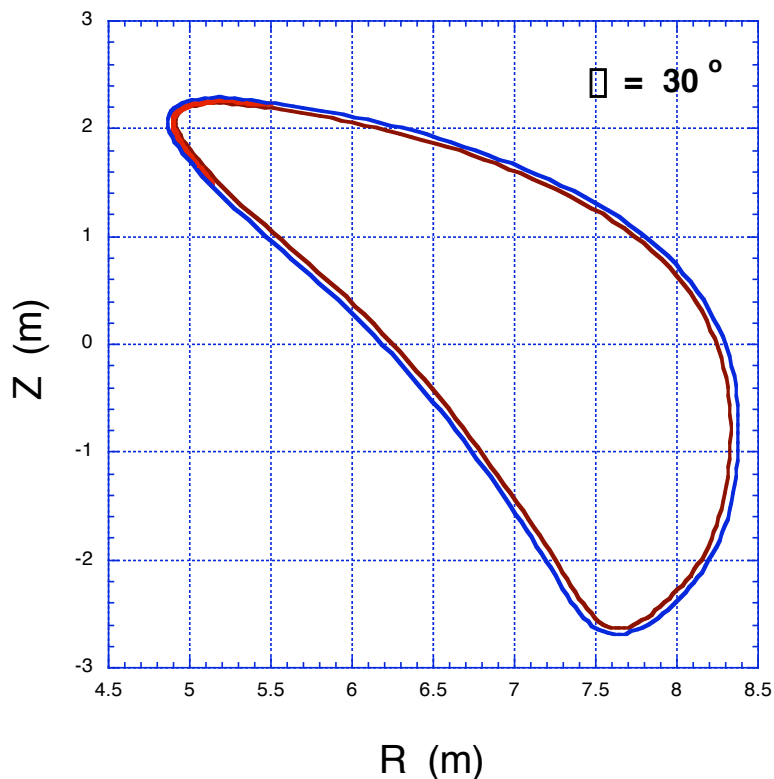
Target area = 148 m²

Baffle area = 128 m²

Target/Baffle coverage $\approx 10\%$

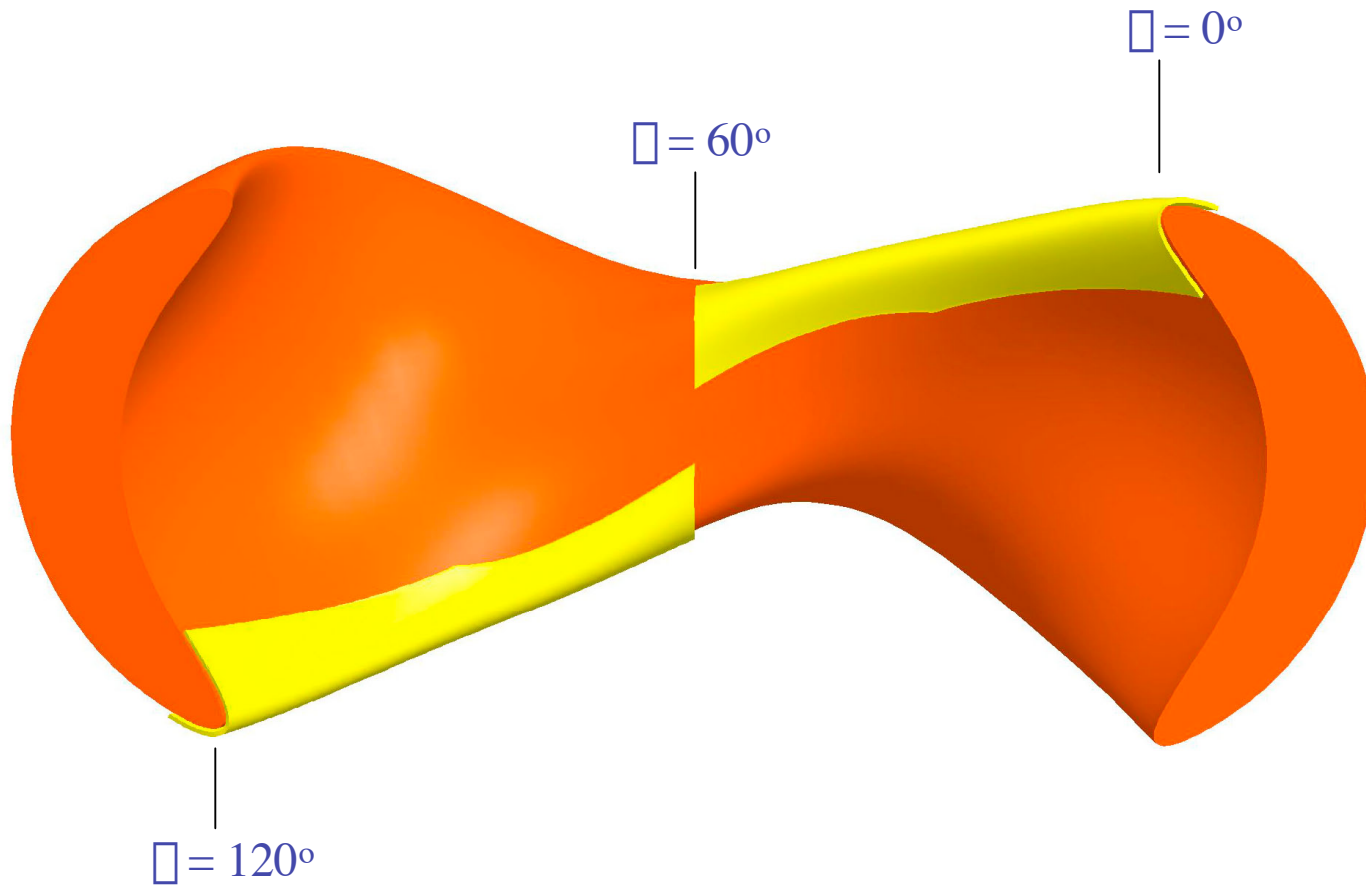
Divertor Plate Geometry modeled on W7-X and HSR

- There are six plates, with one in each half-field-period.
- First wall and LCMS offset = 5 cm;
Shortest distance between plate and LCMS = 1 cm @ $\varphi = 30^\circ$
- Each plate has toroidal extent of 60° and poloidal extent of 60° , with
$$\begin{array}{ll} 0^\circ < \varphi < 60^\circ & \text{above mid-plane} \\ 60^\circ < \varphi < 120^\circ & \text{below mid-plane.} \end{array}$$



CAD Drawing of Divertor Plates in One Field Period

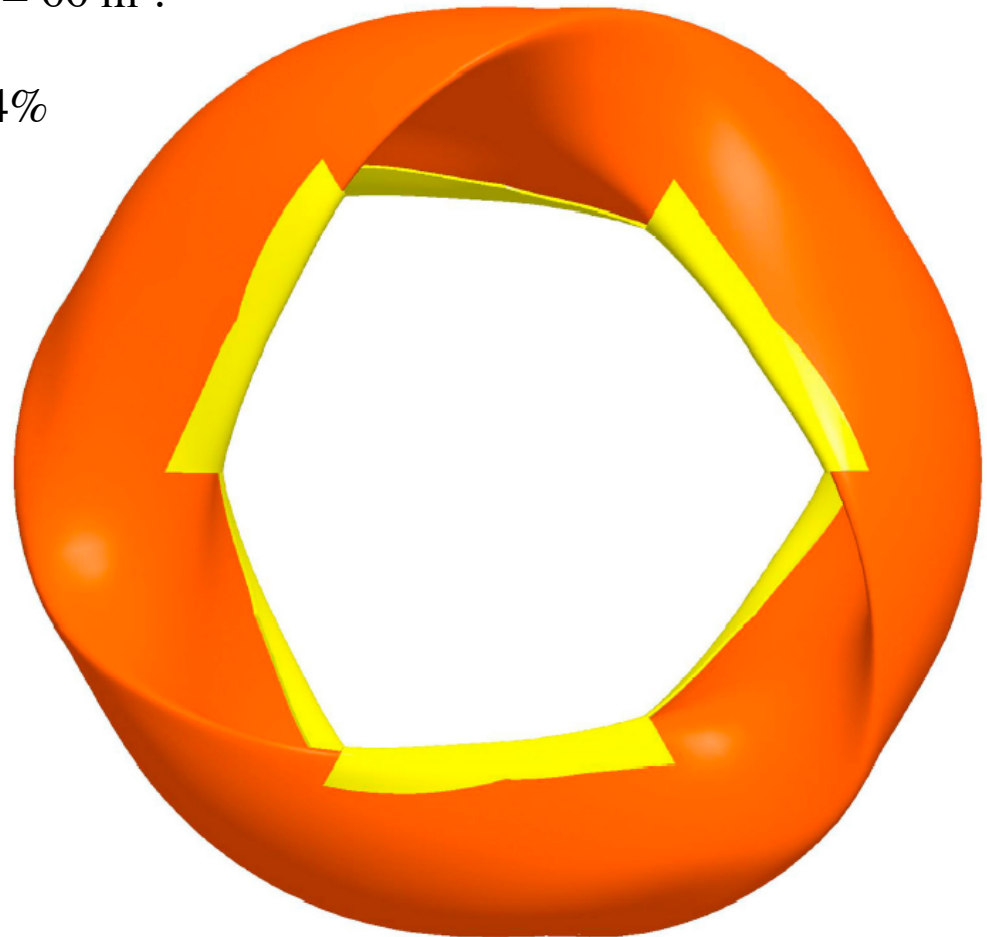
- Surface area of each plate = 11 m²



CAD Drawing of Six Divertor Plates in ARIES-AE

- For a total of six plates, surface area = 66 m².

Surface area coverage fraction = 9.14%



Status of Divertor Heat Load Analysis

- A few test runs with ~ 100 field lines for a “conformal” plate geometry in the $R=8.25$ m case resulting in a large number of field lines intercepting either the wall or the divertor plate, with the rest either still circulating or “bogged” down by some numerical issue.
- Each of these runs uses up to 6 hours of clock time on SEABORG and was stopped before the heat load relevant output files are generated. This appears to be caused by excessive time used in the process of identifying strike point locations on the plate.
- The latest finding is that this may be caused by “spurious” isolated points (or lines) in the SOL being mis-tagged by GEOM as a divertor plate surface, leading to problems in the strike point identification algorithm. Investigation is on-going.

Plans for Divertor Heat Load Analysis

- It is believed that the numerical issue with GOURDON is on the verge of being solved.
- Mike Canavan (RPI) has agreed to spend two weeks in UCSD to help resolve the problem with GOURDON, and finish the divertor design for ARIES-CS before next meeting. He is available to work full time on the project.
- Submit abstract to 17th TOFE conference, Albuquerque, November, 2006. [extended deadline: July 9]

Plans for Alpha Particle Heat Load Analysis

- With a tight time schedule, a simplified plan is being worked out to assess the fraction of alpha particles striking the first wall.
 - Use ORBIT3D code results to find footprint on LCMS of alphas exiting plasma.
 - Pick a case with low alpha loss fraction.
 - Footprint on LCMS mostly in the lower right quadrant (?)
 - Use GYRO to follow alphas in SOL, assuming random gyro-phase.
 - Develop a simplified algorithm to determine strike locations on the divertor plate/baffle and the first wall, using a tag map from GEOM. [most uncertain part]
- The end result should contain the distribution of alpha strike points on the plates and first wall, together with particle energy and intersection angle.
- Submit abstract to APS/DPP meeting, Philadelphia, 2006 by July 21, if enough progress is made.