Power and Particle Control Work-Plan

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Power and Particle Handling - Work Plan

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Goal of the plasma boundary operation is to contribute to optimizing confinement, stability, and pulse length.

Basic physics requirements:

1. Sufficiently long connection lengths to support low-temperature, high recycling divertor operation at high separatrix temperatures
2. Effective neutrals and impurity control for good confinement
3. Controlled heat removal for minimum impurity generation

Machine requirements:

1. Design vacuum vessel shape/dimensions to accommodate:
   a.) connection lengths of ≥120m
   b.) divertor hardware: heat removal plates (3MW/0.5s), neutrals baffles, future pumping hardware
2. Design plasma-facing components for heat removal and neutrals baffling
3. Provide flexibility for PFCs to accommodate range of beta and iota

Power and Particle Handling - Workplan (cont'd 1)

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More detailed workplan (for 1.4m plasma and 18-coil field):

A. Need to apply fieldline-following Gourdon code with diffusion turned on and plot punctures in poloidal planes every 5 or 10 degrees toroidally to completely map out field line excursions and "stay-out" zone... The goal is to have a high percentage of the field lines (60-80%) with connections lengths of ≥120 m.

B. Generate footprints on conformal surface and then on (iterative) divertor plate for the design of divertor location/shape and baffles.

C. Configurational flexibility of plasma boundary: need to do field line and footprint mapping for range of iota, beta, and edge turbulence.

D. Develop model calculations to guide the design of divertor baffles for neutrals control… goal is to optimize neutrals confinement by baffles and minimize neutrals penetration around v=0 cross-section. 2-D calculations are in progress and 3-D calculations are planned.

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E. Develop edge plasma profiles from fluid modeling: will include 2-D modeling and likely some first 3-D examples; need power flux on divertor plates with peaking factors which take into account diffusion, turbulence, etc.

F. Develop deposition pattern of fast particles on the wall and divertor plates/baffles. Estimate power and particle fluxes.

G. ...

First Poincaré Plot With Diffusion Turned On

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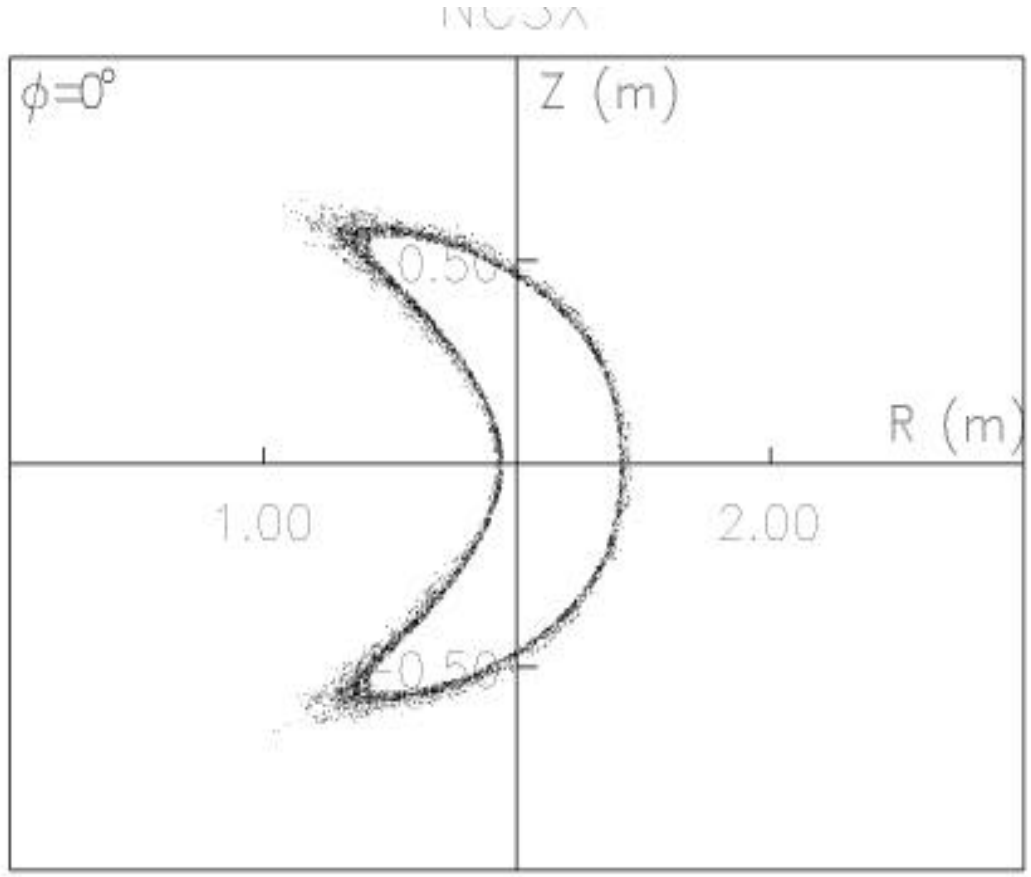
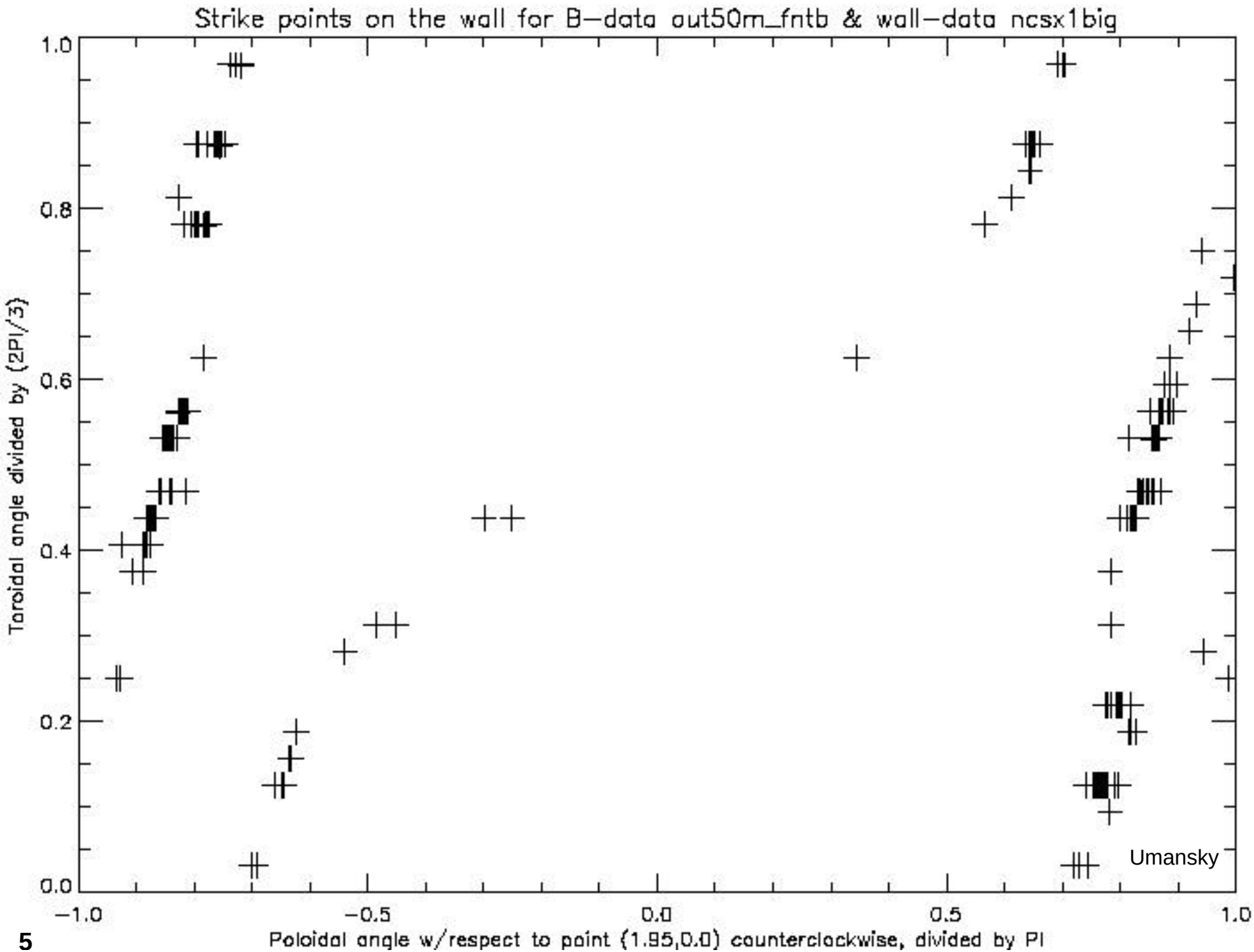
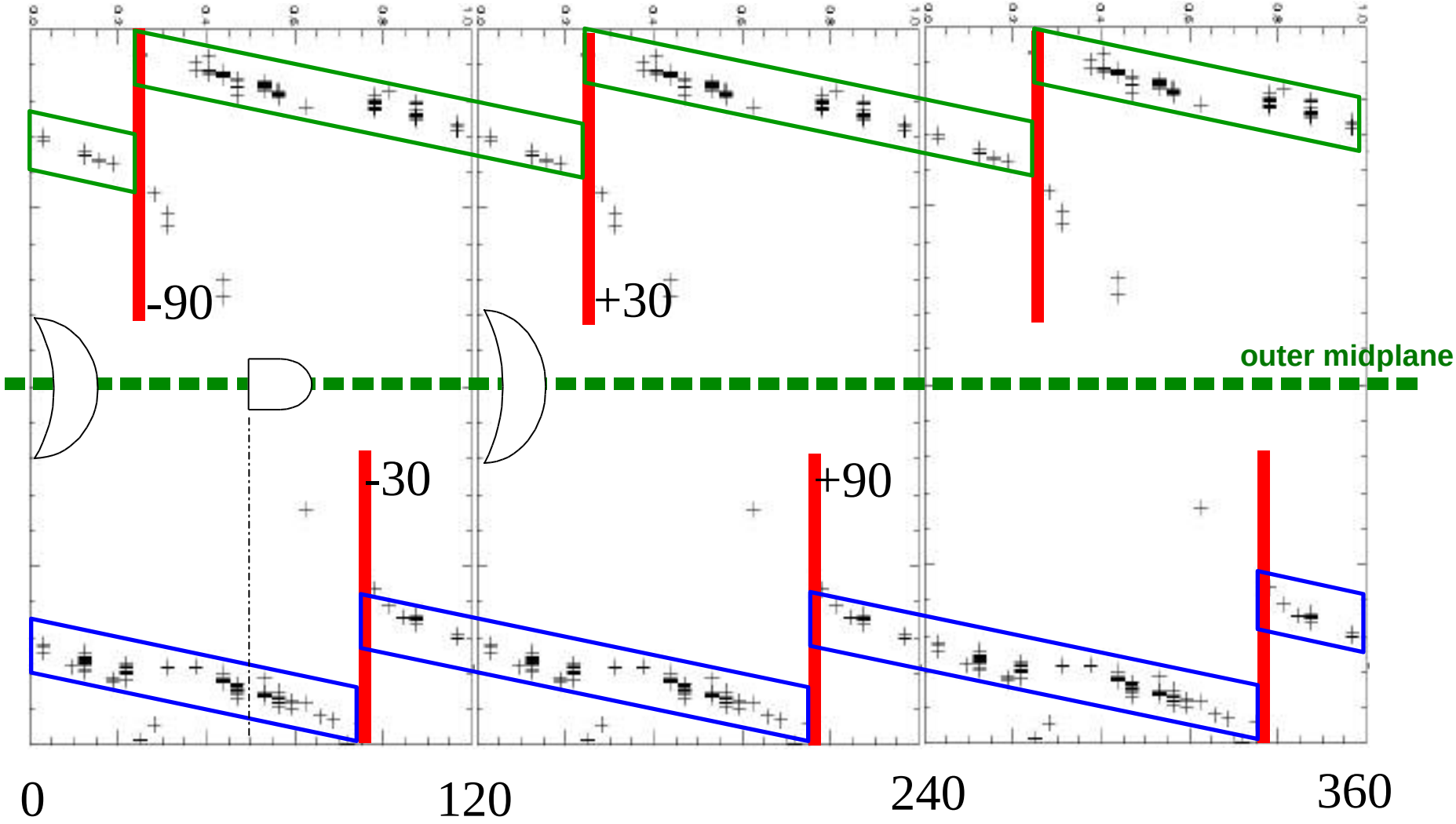
Koniges




Strike points on the wall for B-data out50m_fntb & wall-data ncsx1big
Toroidal angle divided by (2PI/3)
Poloidal angle w/respect to point (1.95,0.0) counterclockwise, divided by PI
1.0
0.8
0.6
0.4
0.2
0.0
-1.0
-0.5
0.0
0.5
1.0
Umansky

Divertor Plates for the NCSX divertor



length: L = 2 π R = 6.9 m; width: w = 0.4 m; total area: A = 5.5 m^2

3-D View Shows Coverage Of Helical Edges

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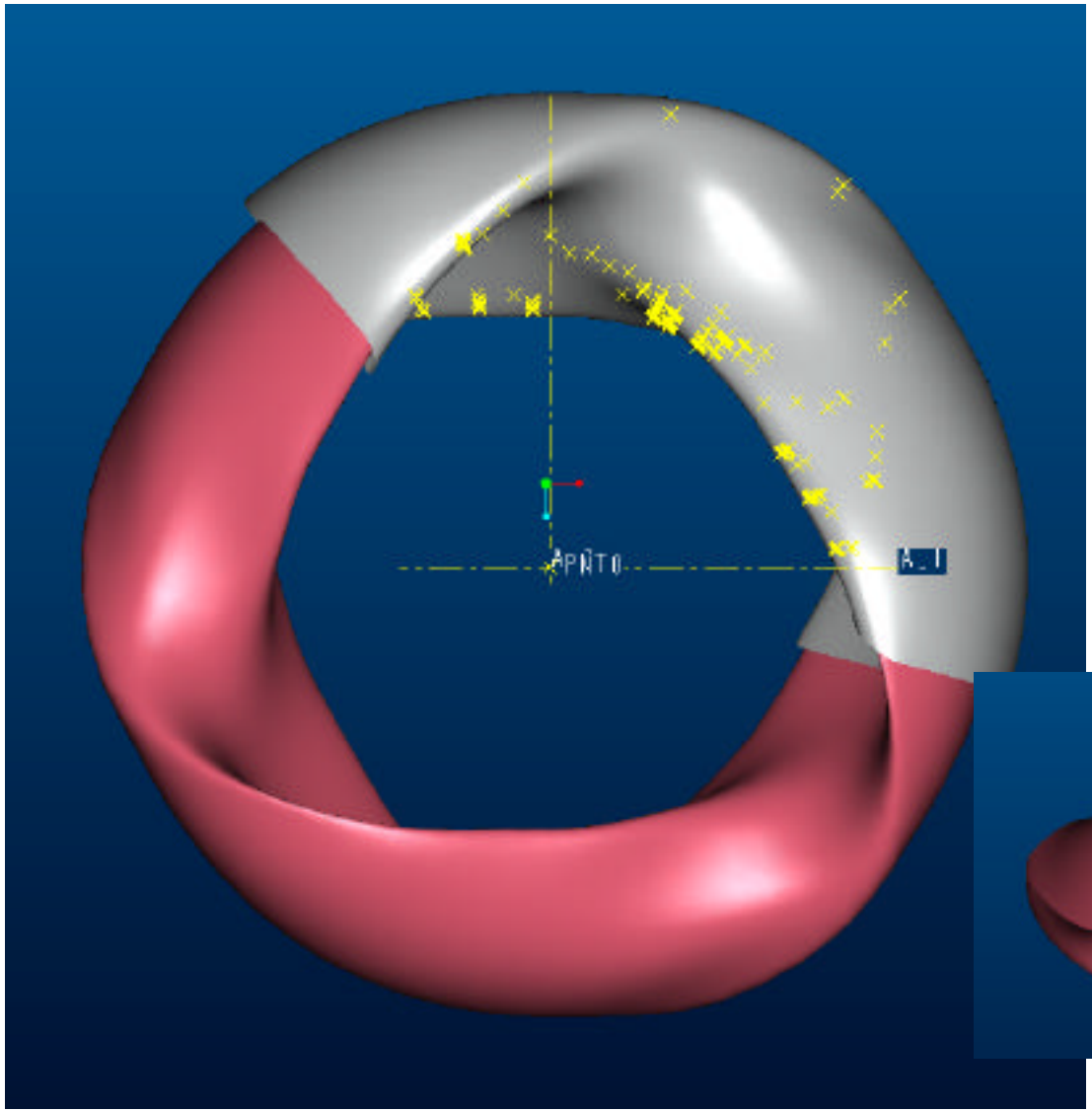
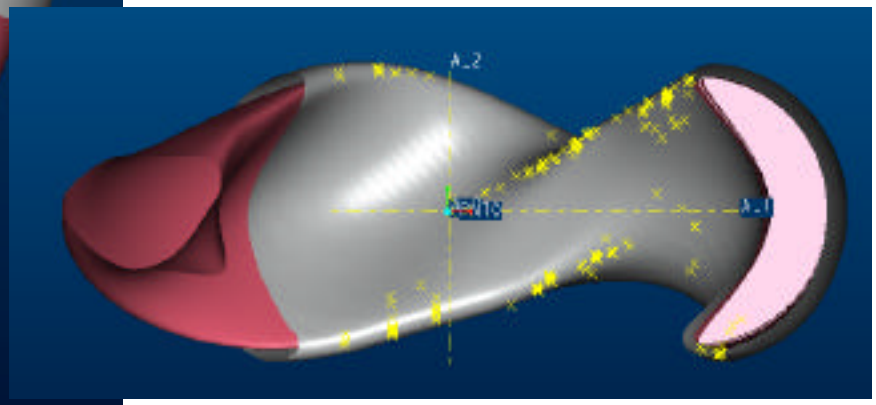
The helical edges are closely covering the configuration toroidally (~ 120º)