# DEVELOPMENT OF A PARAMETRIC CAD REPRESENTATION FOR NEUTRONIC CALCULATIONS OF A STELLARATOR POWER REACTOR

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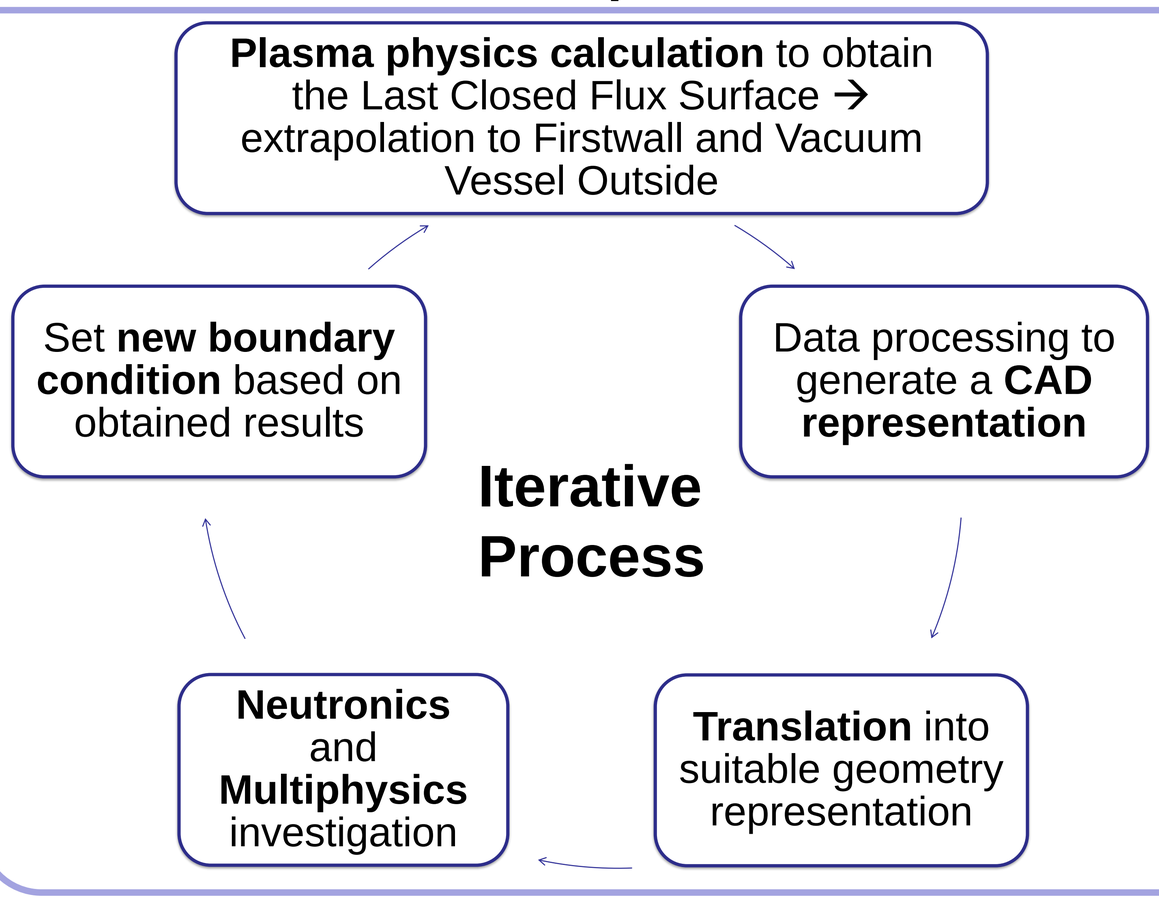
## Motivation and Objective

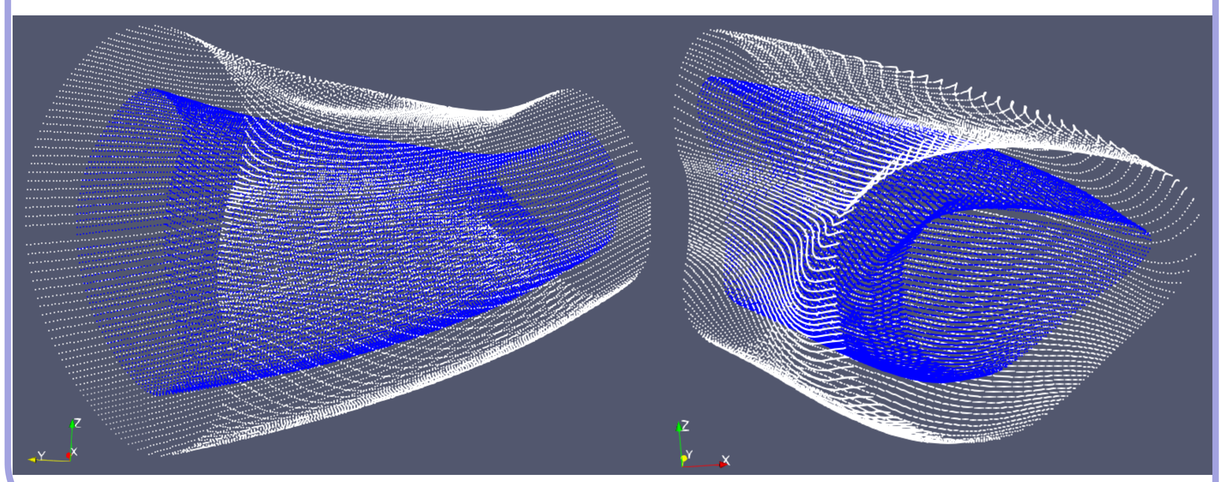
- Helical-Axis Advanced Stellarator (HELIAS) is a demonstration power reactor with 3000 MW D-T fusion power.
- Stellarator optimization is an iterative approach involving different research fields.
- Neutronic investigation using CAD geometry with DAG-MCNP (DAG = Direct Accelerated Geometry) approach.
- CAD stellarator model consists mainly spline surfaces which can not be handled with traditional MC geometry translation approach.
- Development of a new open source, parametric CAD representation to obtain a flexible modeling approach.

## Stellarator Optimization



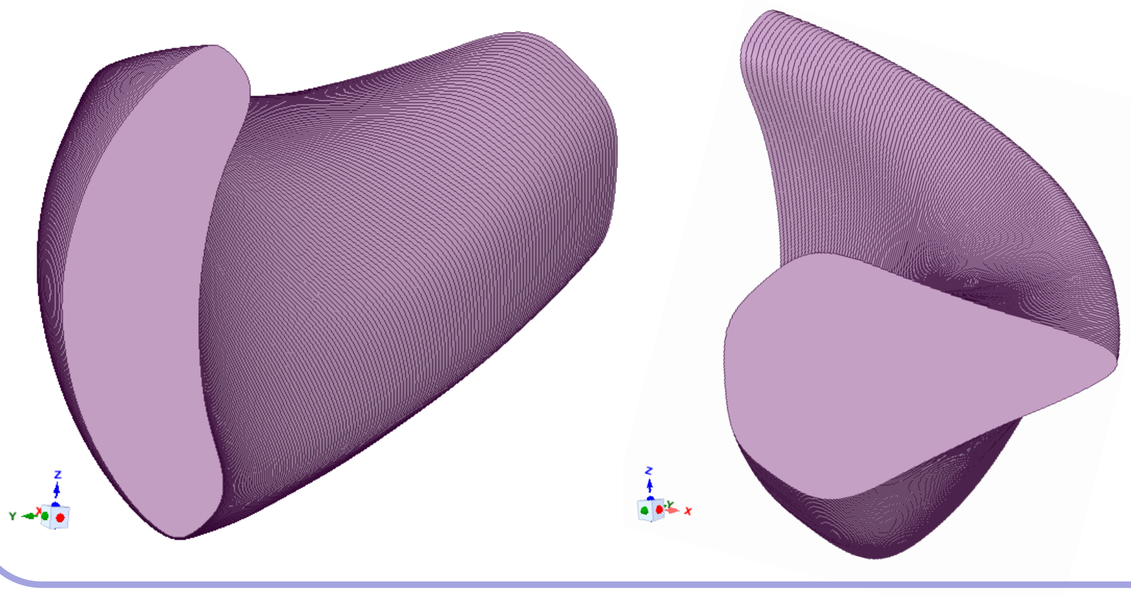

## Input and Data Processing

- **36° HELIAS stellarator** model → representing a half field period.
- Data points describe the shape of the **Firstwall (blue)** and **Vacuum Vessel Outside (white)**.
- Input data is processed into a format to generate the CAD geometry.



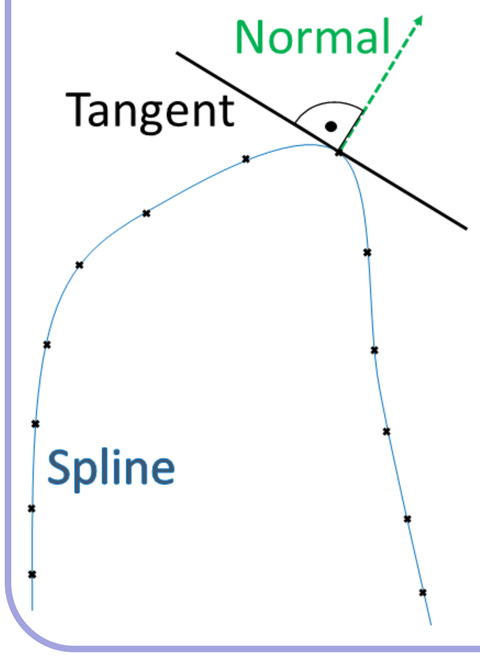
## First CAD Design

- **FreeCAD** sweep function is used to process the data points into a solid model.
- Spline function describes the surface.
- CAD geometry can be processed with the DAG-MCNP workflow to obtain a **MC suitable neutronics model**.

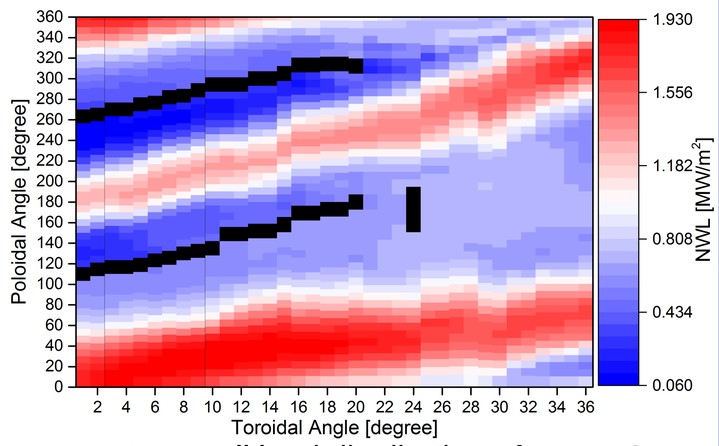


## Future Developments

- **Generation of functional layers** → using a tangent at the spline curve to create new layers along the tangent normal.




- Perform **nuclear design analyses** to obtain nuclear responses like tritium breeding ratio and shielding performance, and re-investigation of the neutron wall loading.



Neutron wall load distribution of HELIAS

## Conclusion and Outlook

- *Stellarator optimization:* Iterative process involves different research fields to optimize the stellarator design.
- *Input data:* Based on the last closed flux surface, given by the shape of the non-planar superconducting magnetic field coils.
- *CAD design:* Generation by FreeCAD with the model sweep function to obtain a spline surface.
- *Future developments:* Generation of functional layers, integration of engineering components and perform design iterations.

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