

# Neutronics Model for the Stellarator Power Reactor HELIAS

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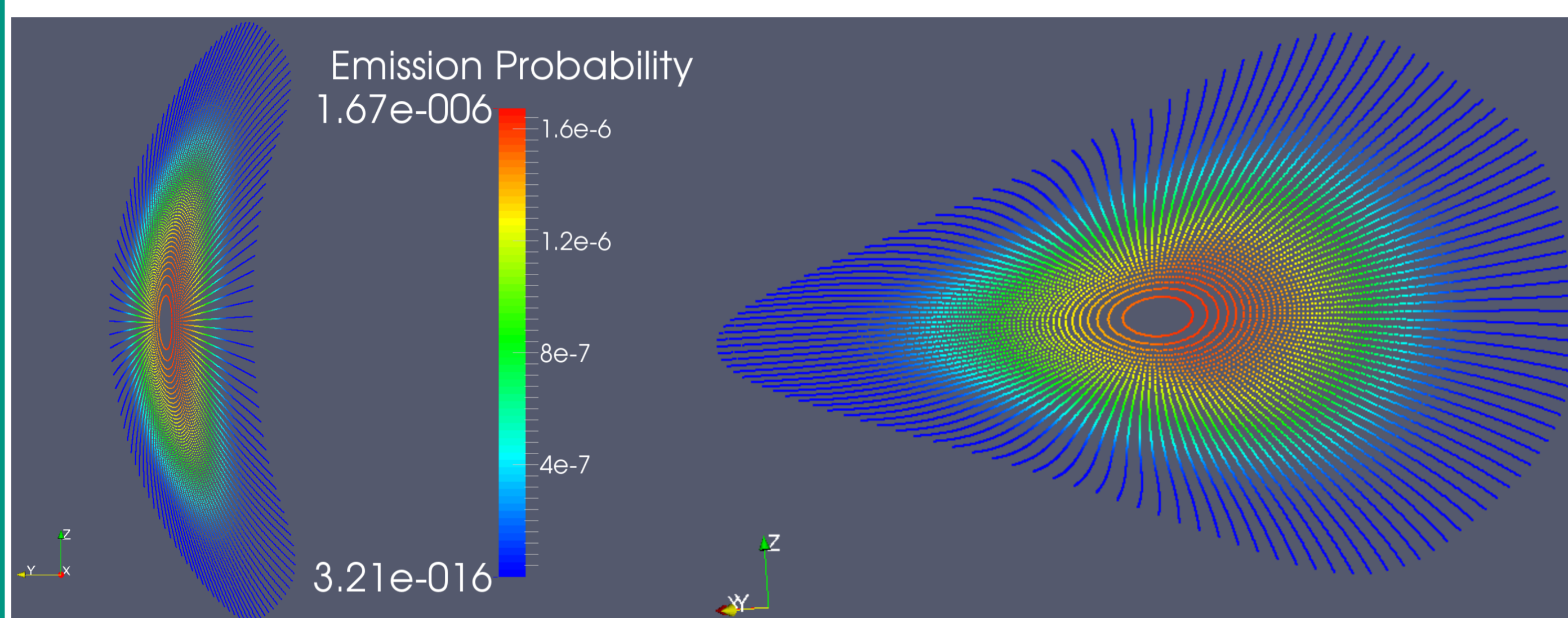
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## Objective

The objective is to develop a suitable computational approach for neutronic analysis, with the Monte Carlo n-particle transport code MCNP, of a stellarator type fusion power reactor and apply it to the design analysis of the Helical Advanced Stellarator (HELIAS) demonstration power reactor with D-T fusion and 3000 MW fusion power.

## Data

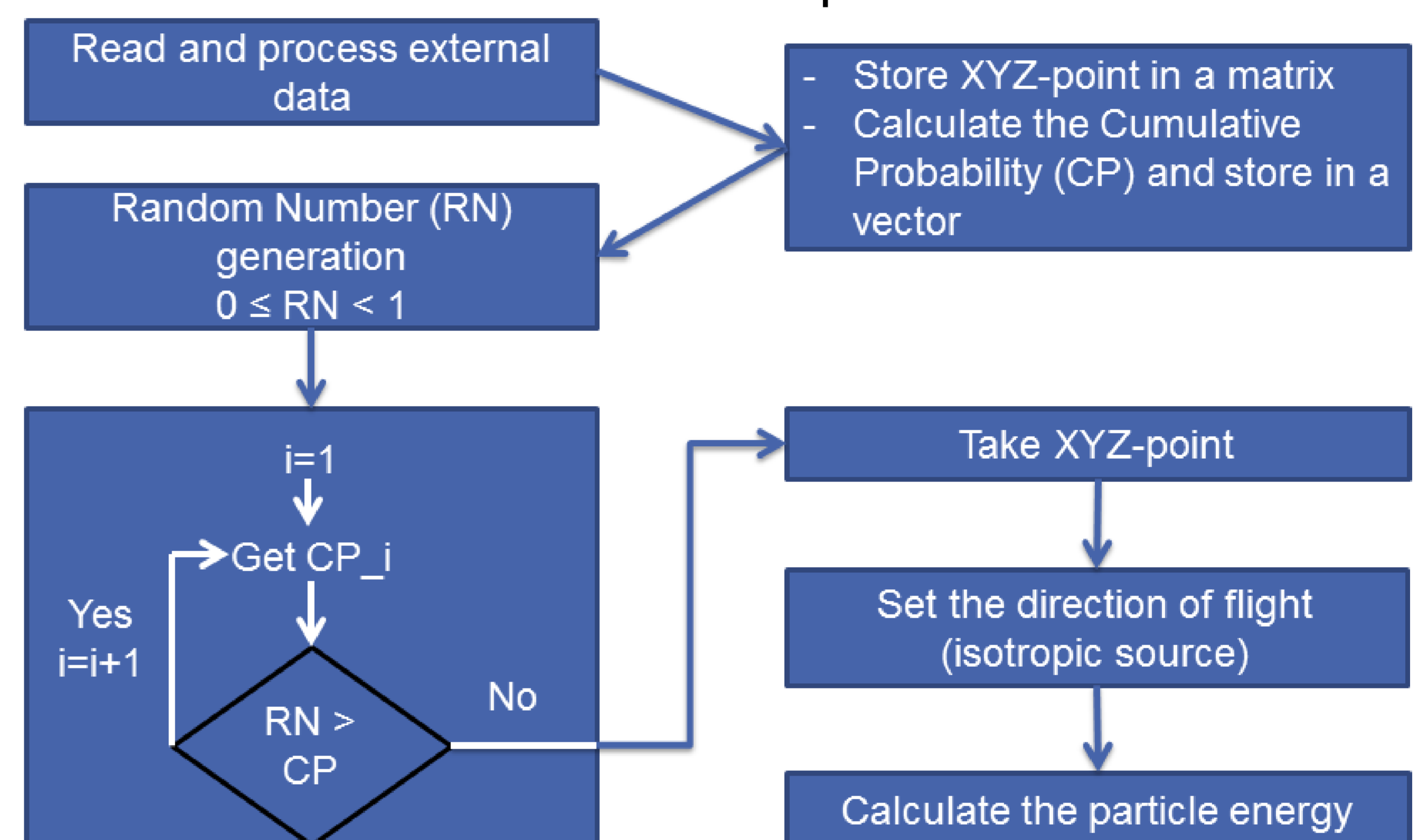
- Based upon a plasma physics calculation at Institute for Plasma Physics, Greifswald (IPP Greifswald).
- Input Data: Plasma density distribution inside the stellarator linked with a specific neutron emission probability.



Emission probability of the source perpendicular to the main axis

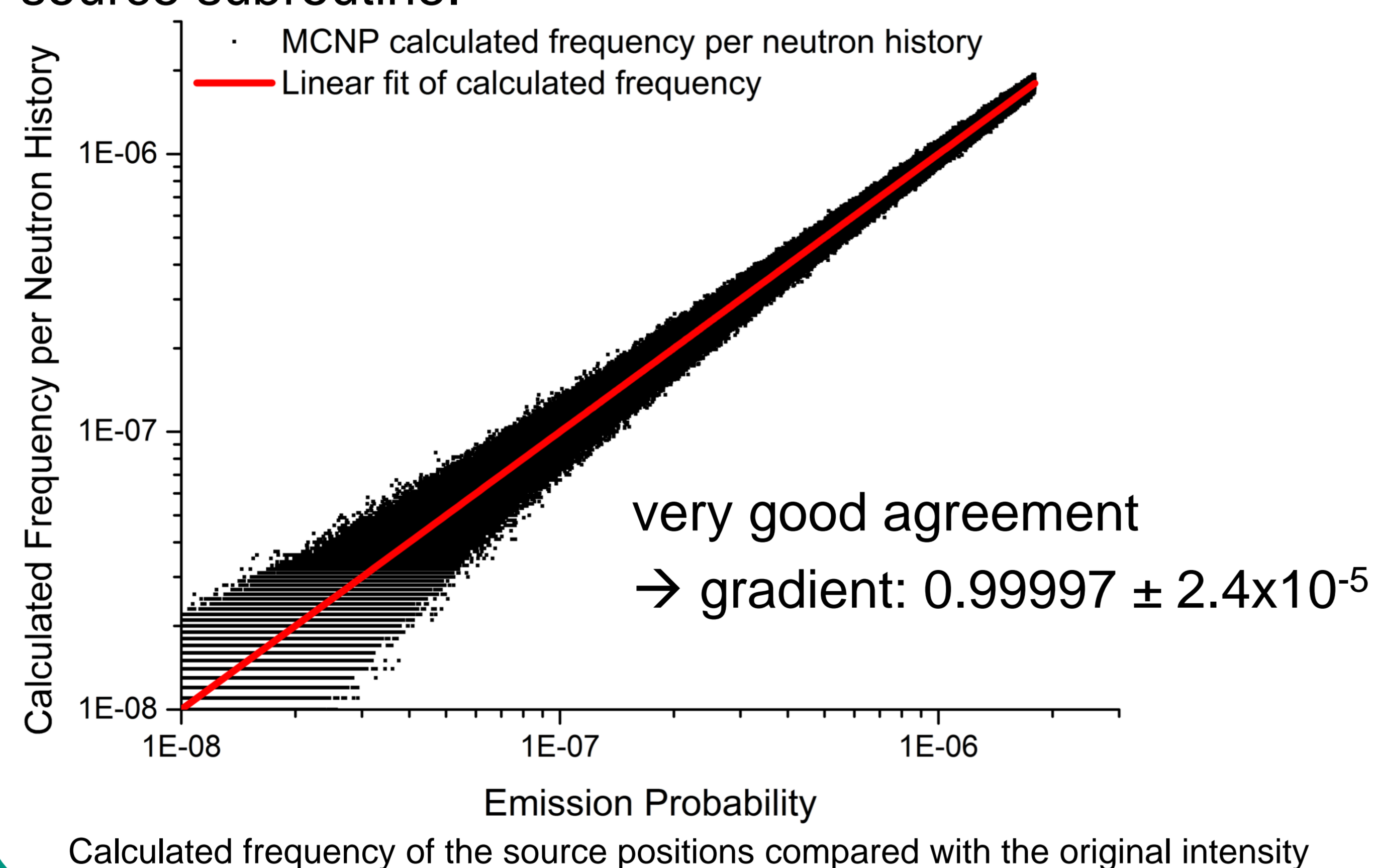
## Method

Data from plasma physics calculation is stored in an external file, which can be read and processed by the MCNP source subroutine developed in this work.



## Results

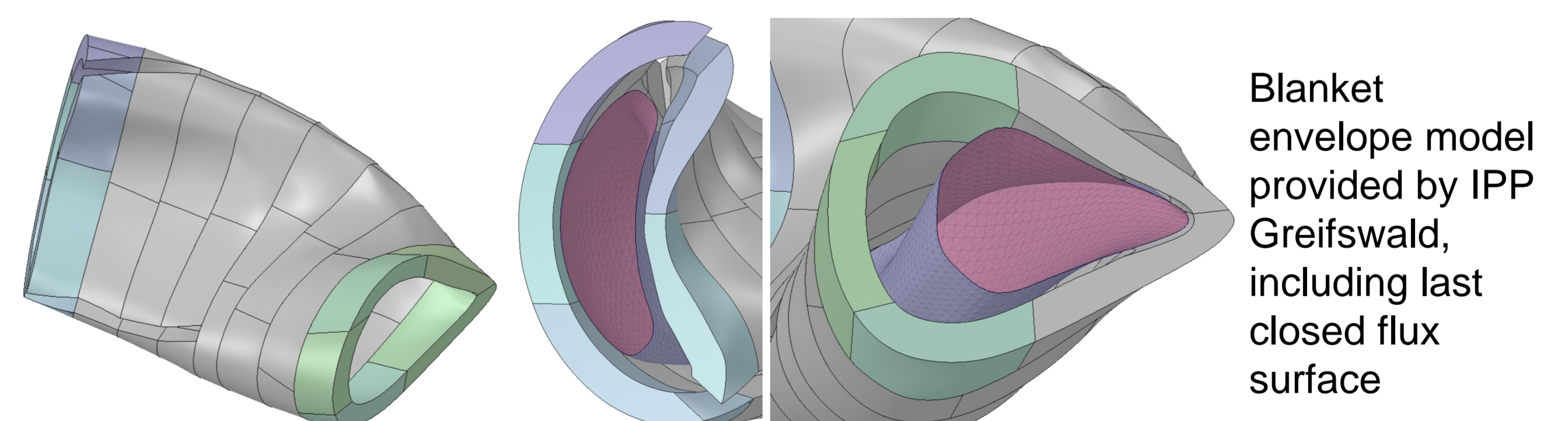
Verification the source point sampling of the developed source subroutine.



## CAD Geometry

Three different approaches will be investigated to create a CAD based MCNP geometry:

- Traditional CSG: "Geometry translation approach" with KIT's CAD to MCNP conversion tool McCad → fully developed procedure for Tokamak reactors
- Faceted Solid: Direct tracking of particles in CAD geometry by using DAG-MCNP (DAG = Direct Accelerated Geometry)
- Unstructured Mesh: Tracking of particles in MCNP6



## Conclusion and Outlook

- 3-D Stellarator neutron source: development and testing have been successfully achieved.
- Geometry modelling: preliminary model needs further development (first wall, breeding zone, manifolds etc. are currently missing).
- Nuclear design analyses: neutron wall loading, nuclear heating, neutron flux distribution, shielding performance, tritium breeding performance, radiation damage.