Gauss Fusion Neutronics Overview

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Gauss Fusion GmbH has recently established an open-source software-based workflow for stellarator neutronics that enables comprehensive and reproducible simulations of full-device stellarator machines. The framework integrates established community tools, including STELLOPT for magnetic equilibrium optimization, ParaStell for homogenized geometry generation, Coreform Cubit© and Gmsh for models meshing, and OpenMC for neutron and photon transport simulations. This integrated approach provides a robust and user-friendly environment for neutronics analyses of complex three-dimensional stellarator geometries. A key challenge in stellarator design is the accurate treatment of non-axisymmetric machine configurations, particularly when assessing breeding blanket performance and shielding properties under realistic engineering constraints. The developed workflow streamlines geometry preparation, meshing, material assignment, and transport simulation, thereby improving reproducibility, and accelerating iterative design studies. As a next step, Gauss Fusion has recently started to work on analyses of engineering design of the breeding blanket modules paving the way to the high-fidelity neutronics output.

In this contribution, we present the achievements in the neutronics assessment of a Tritium Breeding Blanket (TBB) concept HEXA® for the future stellarator power plants. The analysis evaluates critical performance metrics such as tritium breeding ratio, tritium production maps, nuclear heating, and radiation damage indicators across the blanket, lifetime components, and superconducting magnets. We demonstrate the capability to support detailed performance evaluation and rapid parametric studies for HEXA®, providing input for thermal-mechanical and CFD analyses, tritium transport modelling (FESTIM), information on radiation damage and nuclear waste assessment.