P 5: Helmholtz Graduated School HEPP I

Time: Monday 16:00–17:05 Location: P-H12

P 5.1 Mon 16:00 P-H12

From Idea to Virtual Design: Systems Studies of Stellarator Fusion Power Plants — •Jorrit Lion, Felix Warmer, and Robert C. Wolf — Max Planck Institute for Plasma Physics, D-17491, Greifswald, Germany

Stellarators are attractive candidates for fusion power plants: They operate inherently in steady-state, lack current driven instabilities and do not rely on current drive and or poloidal field coils. To design and model such a power plant, so called systems codes can be applied, which aspire to model all relevant features and constraints of the power plant within a single framework by imposing simplified 0D or 1D models. We report on a new version of the fusion reactor power plant systems code PROCESS, applicable to general stellarator configurations, based on its coil set and the 3D plasma shape [1]. This is achieved by introducing a pre-calculation step to determine effective parameters, which are then being passed to new stellarator specific models in PROCESS. This way, 3D coil-forces, 2D thermal wall loads or stellarator specific operational boundaries can now be modelled within PROCESS. Using these modifications, PROCESS now allows for a combined technological, physical and economical assessment of a very general class of stellarator power plants within a systems code framework. This opens up a new paths to speed up the design cycle and potentially accelerate the deployment of fusion.

[1] J. Lion, et al., ”A general stellarator version of the systems code PROCESS”, Nucl. Fus. 61 (2021)

P 5.2 Mon 16:25 P-H12

Analysis of multiple MMC submodules operation for future ASDEX Upgrade power supply system integration — •Antonio Magnanimo[1], Markus Teschke[1], Gerd Griepentrog[2], and the ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, 85748 Garching, Germany — [2]Technische Universität Darmstadt, 64283 Darmstadt, Germany

The modular multilevel converter (MMC) has become one of the most attractive converters for high-power applications such as High Voltage DC (HVDC) Power transmission, but also fusion devices power supplies. This converter, thanks to the discrete-leveled output voltage and its identical submodules (SMs) by which it is composed, represents a promising alternative to replace the flywheel generator (FG) that actually provides electrical power to ASDEX Upgrade (AUG) device toroidal field (TF) coils. Due to the pulsed DC operation of these coils and their high power needs (up to 150 MW) for each experiment, a small-scale adapted version of the MMC is under development with some differences compared to conventional ones being used in HVDC systems: SM capacitors have been replaced with supercapacitors (SC) modules to increase the amount of available stored energy while SMs belonging to different arms are interconnected to simplify their control and increase the reliability of the converter. This work shows the operation of four SMs connected in series, parallel and combined series/parallel to demonstrate the scalability of the project, highlighting its advantages, challenges and limits.

P 5.3 Mon 16:50 P-H12

Non-Resonant Divertor Design for Compact Toroidal Hybrid (CTH) — •Kelly Garcia[1], Aaron Bader[1], Heinke Frerichs[1], Gregory Hartwell[2], John Schmitt[2], and Oliver Schmitz[1] — [1]University of Wisconsin-Madison, Madison, WI USA — [2]Auburn University, Auburn, AL USA

Non-resonant divertors separate the confined plasma from surrounding structures with the resulting boundary region comprised of cantori and/or stochastic regions, but without the presence of large islands. Compact Toroidal Hybrid (CTH) can serve as a test-bed for non-resonant divertor solutions. The background field coils and the ohmic current drive system of CTH are used to alter the rotational transform between $0.3 < \iota < 0.75$. Utilizing the FLARE field-line following code, we show the presence of a chaotic edge fieldline structure which evolves with current. These chaotic structures are related to topologically relevant transport mechanisms which we aim to explore. We calculate strike point locations for the exiting plasma for multiple ohmic current values. The calculated strike point locations enable us to design and numerically test an instrumented divertor plate with FLARE which can then be used to experimentally measure non-resonant divertor resiliencies with respect to equilibrium changes. The test plate configuration is designed to intercept most of the divertor flux over a wide range of currents. A physical plate is planned to be placed in CTH where we expect to calculate expected heat flux on this plate. We attempt to calculate optimal plate position locations within CTH.