# SYSTEMS CODES STUDIES FOR STELLARATOR OPTIMIZATION

J. Lion[1], F. Warmer[1], R.C. Wolf[1]

1 - Max Planck Institute for Plasma Physics, D-17491, Greifswald, Germany

Email address of presenting author: jorrit.lion@ipp.mpg.de

Designing stellarator fusion reactors is a multidimensional optimization problem: Not only physics optimization criterions need to be addressed, such as low turbulent and neoclassical plasma transport or MHD stability, but also technological constraints need to be taken into account, such as geometrical distances, coil forces or coil bending radii. A burning plasma adds another layer of design uncertainty, mainly given by the alpha particle thermalization fraction and the radial transport of thermal helium. By now, most of these parameters, but not all, can be optimized for in modern stellarator optimization frameworks [1]. However, their relative importance is still not addressed systematically.

One way of approaching this problem is by utilizing systems codes -- computational frameworks that feature simplified models to generate a holistic description of a power plant. Recently, we modified the systems code PROCESS to model generic stellarators, based on filamentary coils and the plasma shape [2]. Besides the ability to obtain a fast and more detailed design point for a stellarator fusion reactor, PROCESS can now also be used to address the formerly mentioned weighting problem in stellarator optimization, e.g. by utilizing respective uncertainty studies. Ultimately, the synthesis of stellarator optimization and systems codes could have potential to path the way to a more cost efficient stellarator pilot plant or stellarator reactor.

[1] Landreman, M., et al. "SIMSOPT: A flexible framework for stellarator optimization." Journal of Open Source Software 6.65 (2021)

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