Analysis of divertor fluxes with proper orthogonal decomposition method in Wendelstein 7-X

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Wendelstein 7-X uses a so-called island divertor for heat and particle exhaust, which uses large magnetic islands to form strike lines on ten divertor units: five on top, five on bottom. This leads to specifics, strongly three-dimensional structure of the heat flux distribution, which is sensitive to magnetic configuration and plasma parameters. During the last campaign, OP1.2b (2018), a few programs were performed where a set of 10 so called control coils (located behind each divertor units) were used to modify edge islands geometry and by that strike line shape and position. Data collected during the discharge by 10 infrared camera systems were analysed by the 2D THEODOR code in order to obtain heat flux distribution across all 10 divertors. However, the analysis is very complicated due to the large amount of data to be considered. The Proper Orthogonal Decomposition (POD) [1, 2] method was implemented to find the correlation between strike line parameters and the additional magnetic field generated by the control coils.

POD method has been applied to investigate multidimensional problem allowing to reduce the number of dimensions in the description. For these studies the time evolution of the heat peak profile and the wetted area were investigated. It was shown that POD modes changed as the considered parameters changed. Comparison of both, heat profile and evolution in time wetted area, with proper time coefficient show clear relation between these quantities.

References

[1] Tanaka H. et al, Plasma Phys. Control. Fusion **60** (2018) 125001
[2] Tanaka H. et al, Nuclear Materials and Energy **19** (2019) 378-383