

Improvements of magnetic diagnostic systems and bootstrap current characterization at the stellarator Wendelstein 7-X

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The second operational phase (OP1.2a) at the stellarator Wendelstein 7-X (W7-X) took place from August to December 2017. Significant improvements of the magnetic diagnostic system have been implemented compared to the previous operational phase. About 90% of the installed sensors were put into operation, which include 2 diamagnetic loops, 6 Rogowski coil arrangements, 36 saddle coils and 125 Mirnov coils, distributed in all 5 modules of W7-X. Measured raw data is directly streamed into the W7-X archive. After each plasma pulse automatized data analyzing software calculates magnetic fluxes of all sensors, as well as the compensated diamagnetic energy and plasma current. Based on this data source, implemented in the MINERVA framework, the reconstruction of magnetic equilibria has been developed using the Variational Moments Equilibrium Code VMEC.

Plasma pulses with a duration of up to 20s in combination with plasma density feedback allowed the application of the magnetic diagnostics for studies of the bootstrap current which are complemented by theoretical predictions. In these studies the minimization of bootstrap currents in certain magnetic field configurations could be confirmed.

Additionally, a plasma heating interlock signal, which is generated from the measurement signal of the diamagnetic energy has been tested and prepared for the upcoming operational phases.