First results from divertor operation in Wendelstein 7-X

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Stellarators provide a potentially attractive concept for fusion power production, owing to their intrinsic steady-state capabilities, and their lack of current-driven disruptions, but high confinement at high ion temperatures has in the past been an elusive goal, primarily owing to prompt orbit losses. This issue is addressed in the new generation of optimized stellarators. Wendelstein 7-X (W7-X) is a highly optimized stellarator experiment that went into operation in 2015 [1-4]. With a 30 cubic meter volume, a superconducting coil system operating at 2.5 T, and steady-state heating capability of eventually up to 10 MW, it was built to demonstrate the benefits of optimized stellarators at parameters approaching those of a fusion power plant. Operation phase 1.2, which was performed in the second half of 2017, featured the full complement of 10 divertor units, ECRH heating with up to 10 gyrotrons, more than 30 diagnostic systems, and a pellet fueling system. This talk will give a general overview of the W7-X goals and capabilities, and describe results from the first divertor operation, including measurements and corrections of error fields, symmetrization of divertor heat loads, evidence of detachment, and operation at significantly higher densities ($n_e > 10^{20}$ m^{-3}), ion temperatures (T_i=4 keV), pulse lengths (up to 26 seconds),
and stored energies (E>1 MJ) than in operation phase 1.1. Various tests of the W7-X optimization will also be reported, and the results will be put into a broader fusion perspective. Finally, an outlook towards the future operation phases OP1.2b and OP2 will be given.

References

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