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Recent Milestones in the Wendelstein 7-X Commissioning

Since the last status report in *Stellarator News* 147, April 2015, the commissioning of Wendelstein 7-X (W7-X) has continued very successfully! Although the evacuation of the plasma vacuum revealed rather quickly that the seals on all turbomolecular pumps had to be replaced, the next evacuation was able to start in the middle of June after a large effort of the assembly group. Further leak checks indicated a few smaller leaks, which were immediately repaired.

In April, the magnet system and the support structure had been cooled down to 4 K, and tests of the two operation modes began. The test of the short-standby mode (SSM) and the standard mode (SM) were successfully finished by the end of April.

Therefore, testing of the superconducting coils started on April 27, 2015. After adjusting all the quench detection (QD) systems, each of the 7 magnetic coils circuits (5 for the nonplanar and 2 for the planar coils), with 10 identical coils each, has been tested at currents up to 5–10 kA. These tests of the single circuits were concluded by mid-June with successful results: no quench, no insulation fault, low resistance at all connections between coils and bus system, and deformations and mechanical strains in the expected range, as calculated from finite element model (FEM) calculations. At the beginning of July the magnetic coil system as a whole was made operational within 7 working days. After a recheck of the quench detection balancing, the limiter configuration was operated at steps of 2, 6, and 10 kA, and with the full current for 2.5 T, i.e., 12.8 kA. Later the standard configuration was commissioned, too. Again, the mechanical movements of all coils were measured and confirmed the FEM simulations. In these phases, the He mass flow in all coils and current leads had to be adjusted to get even cooling, and the energy balance of the insulation and of the current leads had to be reconfirmed. All the systems worked fine and according to predictions.

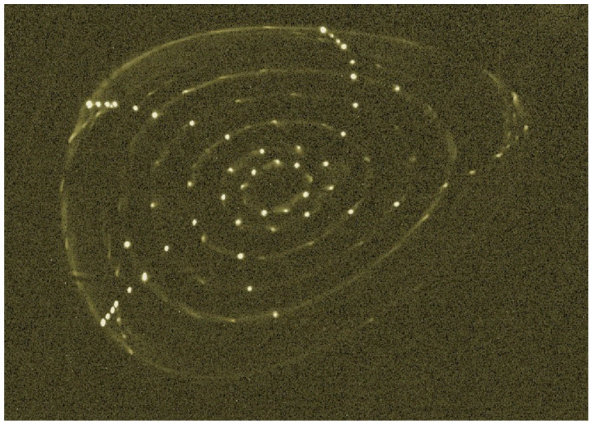

Fig. 1. Well-formed flux surfaces were measured.

In this final stage of the magnetic field testing, the first magnetic flux surface measurements were performed and revealed right from the start good magnetic surfaces, as indicated in Fig. 1. With an electron gun, electrons were created that move along the magnetic field and depict the magnetic surfaces. With a fluorescent stick, which is mapping the cross-section, a Poincaré plot is created that demonstrates the flux surface. With this the most important result of the W7-X assembly and commissioning has been achieved: Wendelstein 7-X has been built with high precision and has a magnetic field structure that will allow it to successfully confine a plasma.

In the coming weeks, the plasma vessel is being baked to 150 °C to clean the inner surfaces, and when all cables, peripheral components, and diagnostics and control sys-

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tems are ready, the device will be ready for operation. First plasmas are expected for later this fall.

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