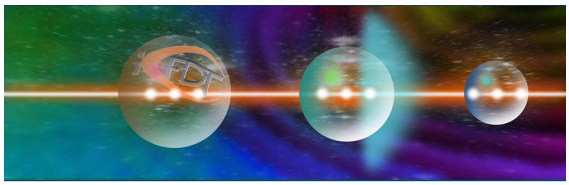

Contribution ID: **54** Type: **Talk**

Diagnostic Capabilities at Wendelstein 7-X Stellarator

Tuesday, 22 October 2024 09:00 (20 minutes)

Wendelstein 7-X (W7-X) is the largest and most advanced superconducting stellarator currently in operation. The primary objective is to demonstrate the ability to maintain a steady-state plasma with fusion-relevant plasma parameters and thus proving that the stellarator is a viable fusion power plant concept. In the most recent test campaign, the new and fully water-cooled divertor was tested with a heating power of up to 7 MW and a long-pulse operation of up to 8 minutes with 1.3 GJ of injected energy was achieved.

While electron temperatures of up to 5 keV and densities of 2.4×10^{20} m^{-3} are found in the centre of the plasma, these drop to a few 10 eV and 10^{19} m^{-3} at the plasma edge. Consequently, a number of different plasma physical effects must be exploited to determine important plasma parameters, profiles, flows or turbulence phenomena. Diagnostics inside the plasma vessel are subject to harsh boundary conditions, including thermal loads in the divertor of up to 10 MW/m^2 as well as plasma and microwave scattering radiation of up to 100 kW/m^2 each. They must therefore be adequately protected and thermally connected to the cooling structures. Another challenge, especially for the safety-relevant diagnostics such as the IR cameras for monitoring the divertor surface temperature, is the long-term operation of up to 30 minutes and the handling of large amounts of data. In addition, the complex 3D magnetic field structure and additional asymmetries of the plasma require extensive mapping techniques for comparisons at different toroidal positions and for different diagnostics.

The presentation will give an overview of the development and application of some diagnostics in relation to the aforementioned requirements.

References:

[1] T. Klinger *et al* 2019 *Nucl. Fusion* **59** 112004
[2] M. Jakubowski *et al* 2021 *Nucl. Fusion* **61** 106003
[3] T. S. Pedersen *et al* 2022 *Nucl. Fusion* **62** 042022
[4] V. Perseo *et al* 2021 *Nucl. Fusion* **61** 116039
[5] Y. Gao *et al* 2024 *Nucl. Fusion* **64** 076060

Primary author: Dr OTTE, Matthias (Max Planck Institute for Plasma Physics)

Co-authors: Dr JAKUBOWSKI, Marcin (Max Planck Institute for Plasma Physics); TEAM, W7-X

Presenter: Dr OTTE, Matthias (Max Planck Institute for Plasma Physics)

Session Classification: Diagnostic for Fusion Machines

Track Classification: Diagnostic for Fusion Machines