23rd EU-US Transport Task Force Meeting, Seville, 11-14 September 2018

# Simulations for identifying microinstabilities in the recent operational phases of Wendelstein 7-X

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Thanks to the optimisation of its magnetic field, Wendelstein 7-X is expected to have low neoclassical transport, making turbulent transport the dominant transport channel particularly at outer radii of the plasma. In the past, theory has predicted a few particular traits of turbulence in Wendelstein 7-X – such as resilience against density-gradient-driven trapped-electron modes (TEM) [1] and the localisation of turbulence in different regions of the plasma. With the first two operational phases of W7-X, OP1.1 and OP1.2a, now behind us it is time to attempt first interpretations of the data, with the goal to investigate whether the theory holds.
As a first step we present results from gyrokinetic simulations using the GENE code [2] applied to the predominantly electron-temperature-gradient-dominated plasmas of OP1.1. Here, comparisons with experimental data obtained with ECE radiometry (see contribution by G.M. Weir) are presented.
In the experiment, fluctuations were observed particularly in the frequency range around 20 kHz. This matches well with the frequency of modes found in simulations with a pure electron-temperature gradient. We therefore tentatively classify the modes observed in OP1.1 as electron-temperature-gradient-driven TEMs.
Further, a particularly interesting discharge of OP1.2 is analysed. In a discharge with pellet injection, an unexpectedly high diamagnetic energy of 1MJ was observed. Might we have to thank an unusually low turbulent transport for this, and if so, how does this low turbulent transport come about? One possible reason might be the increase in density gradient (thanks to pellet injection) relative to the ever-present electron-temperature gradient. For these scenarios, theory predicts a suppression of the TEM. We present quasi-linear estimates of the turbulent heat fluxes for a large scan over a range of both density and temperature gradients, effectively tracing out the path of the discharge.

[1] J.H.E. Proll, P. Helander, G.G. Plunk and J.W. Connor, Phys. Rev. Lett. **108**, 245002 (2012)
[2] F. Jenko, W. Dorland, M. Kotschenreuther and B.N. Rogers, Phys. Plasmas **7**, 1904 (2000)