Addressing turbulence questions in the Wendelstein 7-X stellarator - a combined experimental and theoretical approach

Josefine H.E. Proll[1,2], Paul Mulholland[2], MJ Pueschel[2,3], Maikel C.L. Morren[2], Paul Costello[1], Gavin Weir[1], Ksenia Aleynikova[1], Charlotte Büschel[1], Adrian von Stechow[1], Pavlos Xanthopoulos[1], Gabriel Plunk[1], and the W7-X Team

[1]*Max Planck Institute for Plasma Physics, Greifswald, Germany*

[2] *Eindhoven University of Technology, Eindhoven, The Netherlands*

[3] *DIFFER, Eindhoven, The Netherlands*

With the advent of stellarators optimised for low neoclassical transport like Wendelstein 7-X (W7-X), turbulent transport remains as one of the main obstacles to be overcome for both tokamaks and stellarators on the path to a working fusion reactor. With W7-X, a well-diagnosed advanced stellarator, we can directly probe turbulence in the flexible magnetic geometry and compare against state-of-the-art gyrokinetic codes. Recent findings on electrostatic and electromagnetic turbulence in W7-X will be shown, e.g. how, at much lower normalised plasma pressure than previously anticipated, kinetic ballooning modes that appear below the MHD threshold can lead to an increase in ITG turbulence [1,2] or that heat-pulse propagation experiments confirm rather benign transport caused by electron-temperature gradient modes [3]. We will also discuss whether the density-gradient-driven trapped-electron mode is indeed more benign in W7-X as predicted by theory [4], and discuss currently unanswered questions, such as whether the universal instability, recently [5] found in numerical simulations, can be identified in the experiment and whether it might be the cause of the sudden change in particle and heat diffusivity observed at high plasma density [6].

References

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