Upgrades of the Phase Contrast Imaging Diagnostic at Wendelstein 7-X

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This contribution presents the details of the technical diagnostic upgrades and proposed experiments for the phase contrast imaging (PCI) diagnostic [1, 2] on the optimised stellarator Wendelstein 7-X (W7-X). The PCI system, which measures line-integrated and wavenumber-resolved density fluctuations throughout the entire plasma (e. g. [3]), is a central tool for turbulence characterisation. In preparation for the upcoming long pulse, high performance experiments at W7-X, technical upgrades of the diagnostic have been implemented including a new infrared CO_2 laser, improved optical design, spatial mask filters for radially localised measurements and a feedback system for suppression of low frequency noise due to mechanical vibrations. Additionally, a heterodyne detection scheme using an acousto-optical modulator will be added for measurements in the ion cyclotron frequency range. Various experimental proposals making use of these capabilities are planned for the upcoming experiment campaign: a radial localisation of fluctuations previously inferred despite the line-integrated nature of the measurements [3] will be further validated using the mask filters. Zonal-flow-like oscillations of the poloidal flow velocity have previously been observed. Their nature and origin will be investigated as well as possible connections to coherent MHD modes. A direct comparison of dedicated experimental measurements to global gyrokinetic simulations is envisioned using a synthetic PCI diagnostic [4]. Finally, the improved confinement after pellet injection [5] and other means of profile shaping will be further investigated, in particular with respect to the spatial distribution of fluctuations.

References

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