**Design and component testing for a new steady-state multi-channel dispersion interferometer at Wendelstein 7-X**

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The Wendelstein 7-X stellarator is designed to demonstrate steady-state operation to show the feasibility of the Helias concept for fusion reactors. The experiments conducted so far indicate that high performance can only be maintained with good control over the plasma density profile, for which a reliable density profile diagnostic is required. Dispersion interferometry has proven itself as a reliable steady-state capable density measurement, which can deliver real-time density profile information via inversion with low latency.

The original plan for Wendelstein 7-X already foresees the implementation of a multi-channel interferometer, which was on hold until now. Here we present the current design of the multi-channel dispersion interferometer (MCDI), which will be built in the next 2-3 years. The results of various hardware component tests are presented, which have been incorporated into the design. Notable are damage threshold tests for orientation-patterned gallium arsenide frequency doubling crystal (the non-linear crystal limiting signal to noise ratio), high-frequency electro-optical modulation (determining the temporal resolution) and laser stabilization.

The presented design incorporates various advances from previous interferometers as well as the test results to yield a space efficient and cheap yet powerful interferometer for fast measurement of the density profile evolution. The system is designed to yield a temporal resolution in the mega-Hertz range to contribute to Alfvén mode studies, whilst maintaining a sub-millisecond latency using FPGA-based processing.