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Experimental Comparison of Phase-extraction Methods of Phase-modulated Dispersion Interferometers

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Interferometry in fusion experiments traditionally had to deal with the influence of vibrations on the density measurement. The standard compensation method of two-color interferometry is limited by the accuracy with which the two laser beams can be aligned. In the light of ever-increasing fusion experiments such as ITER or DEMO this becomes an increasingly difficult task. Dispersion interferometry (DI) promises complete compensation with no alignment issues, for which reason it is being employed in an increasing number of experiments.

High density DIs employ phase modulation techniques up to several hundred kilo-Hertz to enable quadrature detection and to be unaffected by amplitude variations. However, the evaluation of the temporal interferogram can be a significant source for phase errors and does not have an established processing method. There are two non-approximation-based methods currently in use: one using the ratio of frequency component amplitudes of the detector signal [1], and a second using its sectioned integration [2].

Each method requires calibration. In addition, each method is affected by phase errors, which in turn affect the calibration itself. In this paper we present an experimental study into automated calibration of both methods and evaluate error sources affecting them. The results are used to retrospectively correct phase measurement errors using the raw data acquired by the W7-X interferometer during the OP1.2 operations campaign and to improve the system. The results have direct consequence on the design of the ITER dispersion interferometer/polarimeter, which is presented.

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References

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