Dispersion scanning beam medium infra-red interferometry for divertor plasma density measurement in DTT

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Abstract:

Dispersion Interferometers (DI) present the fundamental advantage over conventional ones to be insensitive to mechanical vibrations without requiring a second wavelength interferometer to measure path length variations. On the other hand, their optical setup requires duplication of nearly all optical components for any measuring chord. This makes the realization of a multi-channel interferometer that is needed to obtain density profiles via Abel inversion of line integral measurements more complicated. To overcome such drawback of the DI, in this work we propose to join the dispersion technique to the beam scanning one, which has been already successfully implemented in the conventional mid-infrared two-colour interferometer. In particular, we present a preliminary design of a DI scanning interferometer for the new Divertor Test Tokamak (DTT) facility, presently in construction. DTT is designed to study a large suite of alternative divertor magnetic configurations in order to ensure acceptable conditions at the walls while maintaining sufficient core performance. In this contest, measuring plasma parameters in the divertor region is very important though it often presents various difficulties. To improve divertor measurements the proposed interferometer will measure the density along the divertor legs from the strike points up the X-point. The interferometer will use a CO_2 laser (λ =10.6 µm) and a double pass optical scheme. Phase modulation method will be used to improve the resolution of the measurement and to extend the measuring range above the 1020 m−2 line integral limitation of the standard homodyne implementation. Both improvements are important in this application, considering the wide density range expected in the DTT divertor region. Comparing to shorter wavelengths, more commonly used in the DI interferometers, the CO_2 wavelength improves density resolution while providing good immunity to the diffraction effect due to the expected high density gradient.