Design of an interferometer/polarimeter for DTT

D. Fiorucci, P. Innocente, D. Terranova, C. Mazzotta and O. Tudisco

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Abstract:

Laser interferometer/polarimeter systems are used in magnetically confined fusion experiments for simultaneous measurements of the line-integrated electron density and of the current-induced magnetic field. In this work, we present the design of the interferometer/polarimeter system for the Divertor Tokamak Test facility (DTT), a new tokamak device dedicated to investigate alternative power exhaust solutions for the nuclear fusion DEMOnstration Power Station (DEMO). The optical design is based on the exploitation of a 7+7 chords scheme, which allows determining density and poloidal field, contributes to evaluate the plasma magnetic equilibrium and can provide the real time estimate of the q profile. Since the optical scheme is thought to be compatible with a possible Double Null divertor configuration, an equatorial port is recommended. In order to protect the in-vessel optics, each chord employs a back reflecting mirror installed in the high field side inner wall close to the divertor, where some plasma-free space is available, and one retroreflector installed in the space behind the low field side outer first wall. With respect to polarimetric measurements and low effects of density gradients, the optimal laser source solution would be 100/50 μm. With this setup, in low/medium density conditions, the longer wavelength will provide a good magnetic field measurement, while the shorter wavelength will allow vibration compensation for density measurements. In high-density regimes, the short wavelength alone can provide both magnetic field information from Faraday rotation and density measurements from the Cotton-Mouton effect. The two wavelengths are close enough to each other also to provide a good sharing of optical components.