COMPLEX INTERFEROMETRY DIAGNOSTICS COMPLETED

Milan Kalal

Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Brehova 7, 115 19 Prague, Czech Republic

Classical interferometry is the key diagnostics of optically transparent objects (e.g., laser-produced plasmas). Its more *advanced* version, which allows *recording* and subsequent *reconstruction* of up to *three* sets of data from just *one* data object – a *complex interferogram*, was developed in the past and became known as a *complex interferometry* (*CI*) [1]. By using *CI*, not only the usual *phase shift*, but also the *amplitude* of the probing beam as well as the *fringe contrast* (leading directly to the phase shift *time derivative*) can be considered *simultaneously*. The very *origin* of *CI* idea can be traced back to measurements of *magnetic fields* spontaneously generated in laser-produced plasmas [2], where *CI* approach provided results with *spatial* resolutions *far superior* to those of any similar experiments performed to that time. It should be noted, that in these pioneering experiments the *Fresnel-biprism*-based *Nomarski* interferometer was already employed with its functioning *analyzed* later on in detail to suit the best for the *optimal* interferometer *setup* from the point of a subsequent complex interferogram *analysis* [3].

From its very beginning, the method of complex interferogram *analysis* was fully based on *FFT*. Therefore for *practical applications* of *CI* an appropriate *computer software* is required. Such software developed over the years by Kalal and his students can be employed for *reconstructions* of *plasma density* profiles, *neutral gas density* profiles, profiles of *magnetic fields* spontaneously generated in laser-produced plasmas, etc. It can take care of *systematic errors* removal in the case of *imperfect alignment* of individual *optical* components of *any* interferometer used provided the *reference* signal-free interferogram is available. It should be noted that this software also contains a very *fast* and potentially very *accurate* (depending on the *symmetry* of data) *FFT*-based *Abel inversion* algorithm [4]. In its recent upgrades the software also makes possible to go in the *opposite* direction and generate *phase shifts* from reconstructed *density* profiles as well as *interferograms* from the reconstructed *phase shifts*. This feature becomes very useful for *evaluation* of the reconstructed data *precision* and *reliability*.

Attention will be paid to the analysis of *CI practical limits* in its application for the *amplitude* reconstruction using the *reference* interferograms. It will be shown that even in the case of a *not* particularly high quality of the diagnostic beam cross-section the pure *amplitude* effect on the signal part of the diagnostic beam can be reconstructed very well in case of the *diagnostic* beam (as well as the corresponding *optical line*) reasonable *stability* between the *signal* and three *reference* shots (one *reference* interferogram and two *intensity* structures).

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[3] M. Kalal, O. Slezak, M. Martinkova, and Y.J. Rhee, “Compact Design of a Nomarski Interferometer and Its Application in the Diagnostics of Coulomb Explosions of Deuterium Clusters”, *J. Korean Phys. Soc.* **56** (2010) 287-294.

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