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Definition of a metrology servo-system for a solar imaging fourier transform spectrometer working in the far UV (IFTSUV)

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The understanding of the solar outer atmosphere requires a simultaneous combination of imaging and spectral observations concerning the far UV lines that arise from the high chromospheres up to the corona. These observations must be performed with enough spectral, spatial and temporal resolution to reveal the small atmospheric structures and to resolve the solar dynamics. An Imaging Fourier Transform Spectrometer working in the far-UV (IFTSUV, Figure 1) is an attractive instrumental solution to fulfill these requirements. However, due to the short wavelength, to preserve IFTSUV spectral precision and Signal to Noise Ratio (SNR) requires a high optical surface quality and a very accurate (linear and angular) metrology to maintain the optical path difference (OPD) during the entire scanning process by: optical path difference sampling trigger; and dynamic alignment for tip/tilt compensation (Figure 2).

We summarize IFTSUV expected performances from which we deduce the specifications of the metrology servo-system. We also discuss the first mock-up experimental results as well as the design and definition for a space-based application.

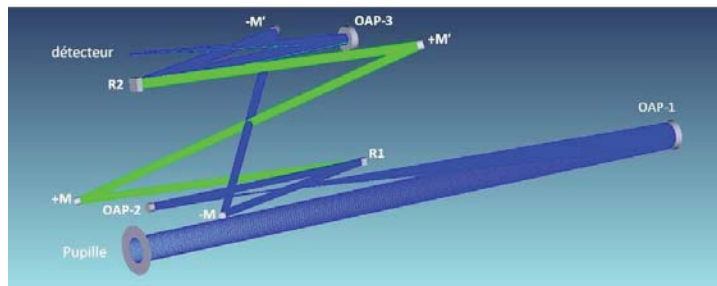


Figure 1. IFTSUV optical layout: an afocal telescope system consisting of two off axis parabolas (OAP-1 and OAP-2) delivers a well collimated beam to feed the IFTSUV input. The incident collimated beam is split by a first grating R1 in the diffraction orders +1 and -1 forming the two respective interferometric arms by means of four plane mirrors (+M, +M' and -M, -M' respectively). After consecutive reflections, the two beams are recombined by means of a second grating R2 (identical to R1). The OPD is sequentially scanned by the translation of the mirror +M'. The interference pattern of the entire FOV is then imaged at the focal plane where the detector is located by means of a third off axis parabolic mirror (OAP-3).

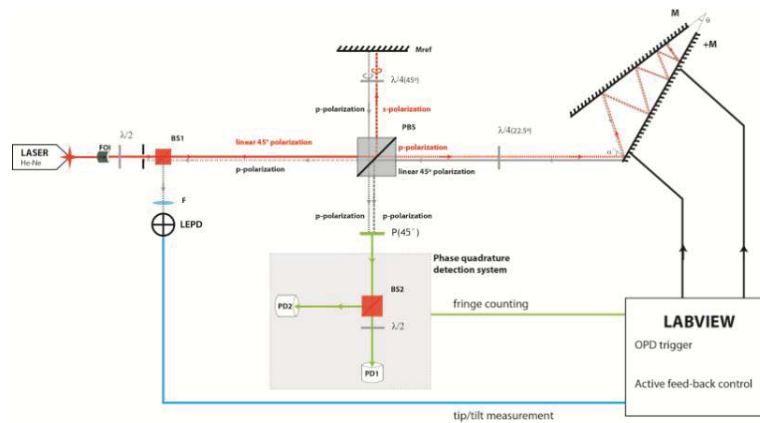


Figure 2. Metrology optical scheme: it consists of a classical homodyne Michelson interferometer whose DC output feeds the input of a deflectometer. Both systems are aligned to the same optical axis, and share a collimated He-Ne laser beam reference source. A quadrature phase detection system enables fringe counting and optical path difference determination thanks to the synchronous homodyne Michelson interferometer sub-system. The deflectometer sub-system lies on a Lateral Effect Photodiode Detector (LEPD) to measure tip/tilt misalignment and two adaptative piezo-actuators for an active feed-back control. To reach the required angular and linear precision the scanning mirror is set to a multi-reflection configuration.