SILMI Final Report

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Portable VISAR Interferometer

The purpose of the visit was the preparation of the conceptual design of portable VISAR (Velocity Interferometry System for any Reflector) devoted for measuring velocity of arbitrary reflecting surface, which could be transportable and applicable for velocity measurement in several laboratories including PALS, LULI, CELIA, and future ELI Czech Republic. This included previous detail study of the operational principles of VISAR diagnostics, velocity measurement, and data analysis and subsequent on-site check of the experimental possibilities of CELIA laboratory.

During my one week stay in CELIA Bordeaux the conceptual design of the VISAR interferometer was prepared and also I become familiar with the experimental conditions in CELIA laboratory. The availability of the optical components and diagnostics equipment such as streak cameras was discussed and solved. In the second stage of the project, i.e. the realization of VISAR, parameters of the individual components will be calculated and purchased.

The stay included one day visit of the LULI laboratory, group of Michael Koenig, where the VISAR interferometer is already well functioning and used during the various experiments. This provided us possibility to easily comprehend the VISAR requirements, typical dimensions, and complexity of the system. Photography of the LULI VISAR is in Figure 1.

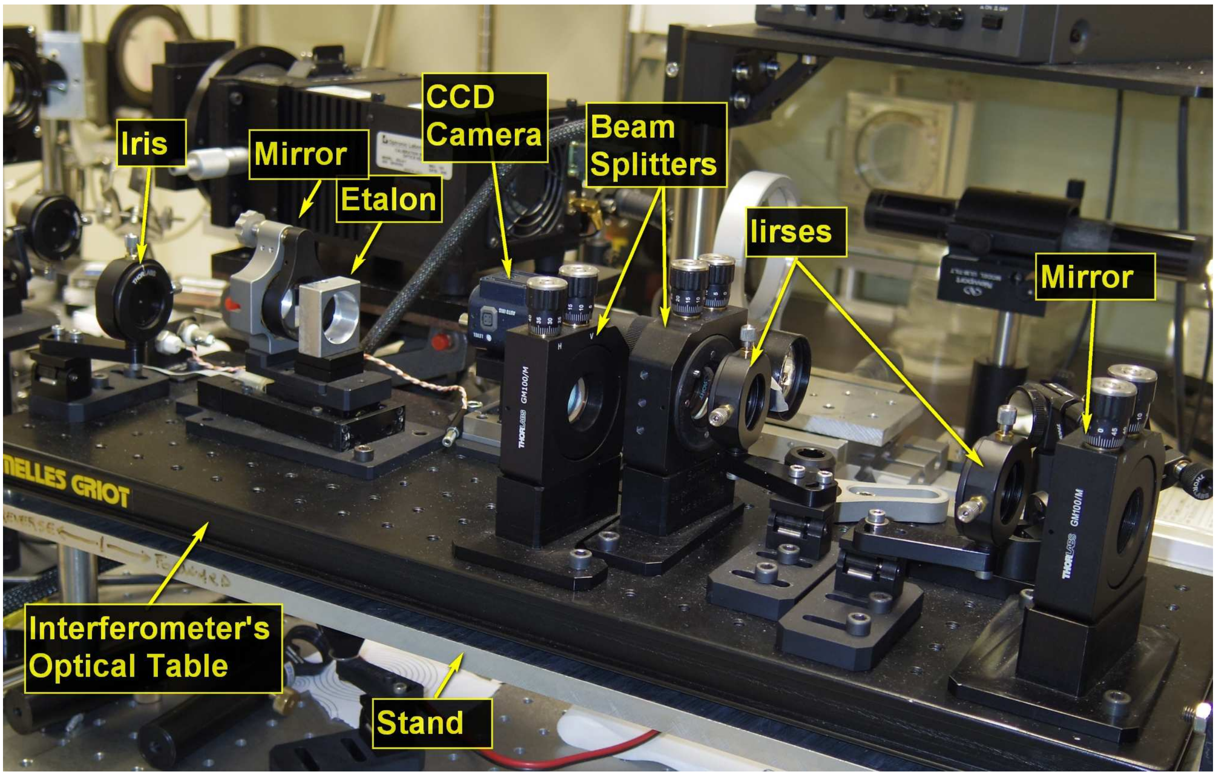

Fig. 1. Interferometer at LULI.

The Mach-Zender type of interferometer comprises of two half-to-half beam splitters, two mirrors, one etalon holder with etalon of various thicknesses, irises for aligning the optimal optical path, and the CCD camera imaging the rear side of the output beam splitter where the interference of the two beams occurs. The etalon defines the resolution of the interferometer. The etalon is together with one mirror placed on the movable micrometer stand. CCD camera is also placed on the movable micrometer stand. Both stands can be operated remotely even inside the interaction chamber using the electronic control system. The concept is the same as the one presented in Ref. 1. The overall dimensions of the interferometer table was about 20x60 cm. To avoid other wavelengths except the probing beam wavelength to enter the VISAR system the wavelength selective mirror was placed in-front of the interferometer.

The same concept is planned to be build for the portable VISAR system proposed for this SILMI grant, however, being even more compact in order to be easily transportable to different experimental facilities. Schematic of the interferometer and the related optics is in Fig. 2.

Based on the first imaging lens the magnification of the system will be derived. The beams passing the interferometer itself will be collimated in order to provide possibility to place the interferometer in arbitrary distance from the first lens.

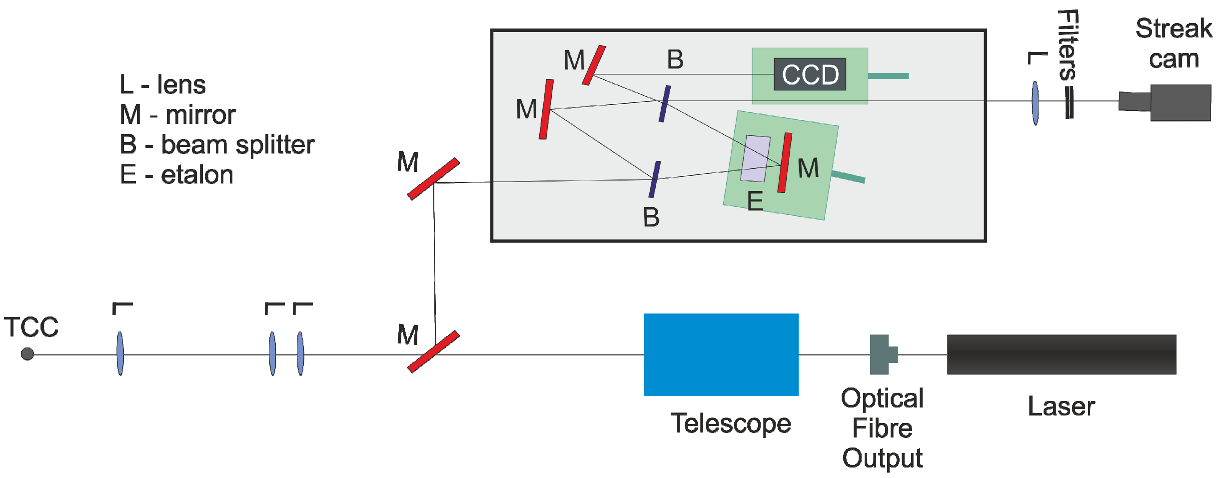

Fig. 2. Layout of the “portable” interferometer. Etalon with one mirror and also the CCD camera are on the movable stages in figure denoted by green boxes. CCD camera serves for the alignment of the interference fringes.

The probing laser and the corresponding optical elements will be placed on separate table. For safety reasons and also the convenience the beam is inserted into the optical system using the optical fibers. In principle, if the dimension of the laser allows this, laser can be placed also on one table together with the interferometer. However, this would mean that in the case when two interferometers are being used, i.e. one with low and one with high resolution, two lasers would be needed, which is not convenient.

The list of optical components required for assembly of VISAR is now being prepared. Mirrors on the interferometer table should be covered with antireflection coatings. Mirror before the interferometer table should be reflecting on the wavelength corresponding to the probe beam wavelength. For easy manipulation the etalon holder can be equipped by magnets as it is done in LULI, see Fig. 3. The thicknesses of the etalons made of fused silica may vary from few millimeters to about three centimeters based on measured velocity.

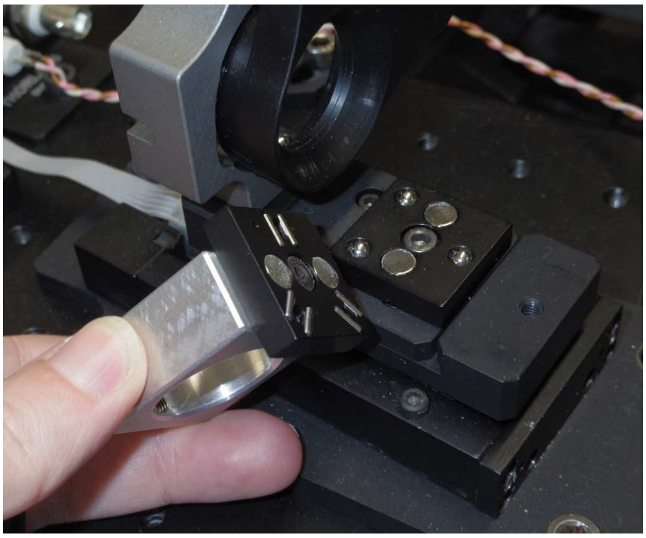

Fig. 3. The magnetic etalon holder from LULI.

The care should be taken also on the solution of the attachment of the individual optical tables to the tables or the existing assembly of facilities where the interferometer is planned to be used. The placement must be robust enough to avoid vibration or motion of the optical components and image.

For future collaboration with the host institution, in the second stage of the planned visits, the interferometer will be assemblied. This shall be after what all the components, i.e. optics, but also holders, and optical tables, will be purchased. Collecting of the components is at the moment the ongoing process. The second visit should take about two months in CELIA laboratory and is scheduled on May/June 2013. After the successful verification of functioning of the first interferometer second can be build in order to realize hi-resolution measurement using two interferometers with two different sensitivity etalons, see Fig. 4.

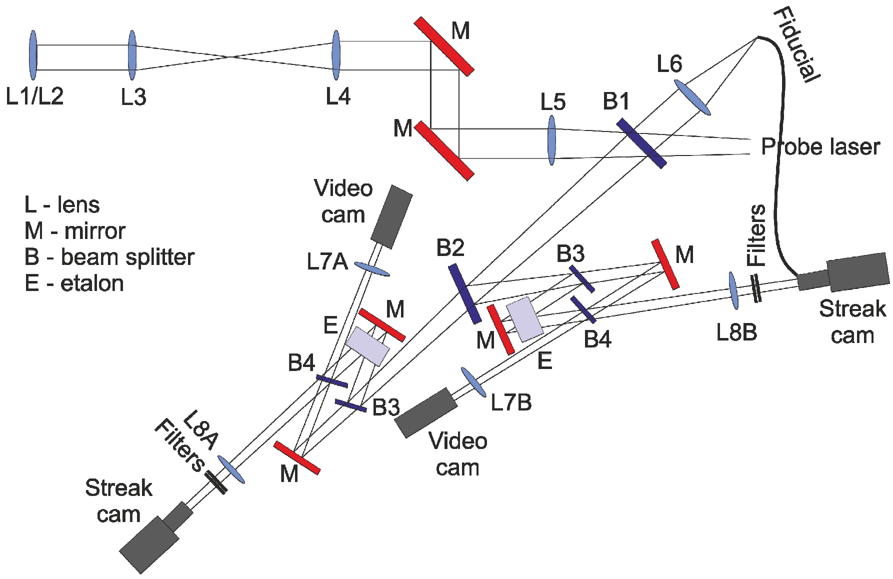

Fig. 4. Example of two interferometers VISAR system.

References
[1] P.M. Celliers, et.al., Rev. Sci. Inst. **75** (2004) 4916