

Ferrara laboratory for birefringence measurements of substrates and reflective coatings

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At the Physics Dept. and INFN section of Ferrara, Italy, we have two working sensitive polarimeters dedicated to measuring the birefringence 2D map of substrate samples, 2D map of the static birefringence of reflective coatings and birefringence noise of high reflectivity mirror coatings. One will be dedicated to static birefringence measurements (substrates and reflective coatings) and the second one to the mirror birefringence noise measurements. At the moment the first polarimeter is based on an entrance polarizer, two co-rotating half wave plates before and after the sample followed by an ellipticity modulator and finally by an analyser set to extinction. The sensitivity of this scheme allows ellipticity measurements of $\text{lesssim} 3 \times 10^{-6}$, dominated by systematics, corresponding to an optical path difference sensitivity of $\text{lesssim} 1 \times 10^{-12}$ m. The second polarimeter has a high finesse Fabry-Perot cavity ($\text{calF} \text{gtrsim} 10^5$) instead of the rotating half-wave plates. The ultimate noise of this second polarimeter is determined by the intrinsic birefringence mirror noise of the mirror coatings (more precisely intrinsic optical path difference noise) which can be measured and not by shot-noise. At ≈ 10 Hz the optical path difference sensitivity of the scheme (with $\text{calF} \approx 10^5$ and output power $P_0 \approx 1$ mW) is $\text{lesssim} 10^{-19}$ m/ $\sqrt{\text{Hz}}$. We will present the two systems and some preliminary results of birefringence maps on small samples.

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