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Interferometric Measurement of Extremely Low Scattered Light from Optical Components

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The interferometric detection of tiny ripples in the fabric of spacetime called gravitational waves require extreme noise sensitive operating conditions for detectors such LIGO, Virgo, KAGRA, as well as the future planned LISA and ET. One such instrument noise source is scattered light from optical components, that can induce phase noise in the output signal by recombining with the main interferometric beam. Therefore, this backscattered light needs to be accurately quantified for improved detector strain sensitivity in the lower detection bandwidth. In this work, we present an optical low coherence back-scatterometer using a broadband light source centered at 1060 nm with optical bandwidth of 70 nm to characterize the very tiny amount of light retro-reflected and/or back-scattered from optical components, thanks to the relative intensity noise suppression using balanced optical detection. The use of a low coherence optical source allows to measure and distinguish the retro-reflection and back-scattering from individual optical surfaces; thus, the accurate contributions of different involved components can be enabled. We measured retro-reflectance from uncoated N-BK7 and S-LAH66 windows and back-scattering from a silver polished mirror with reflectance value as low as 10^-11.

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