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Squeezing Backscatter Evasion

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A peculiar kind of stray light that can affect the performance of a squeezing-enhanced gravitational-wave interferometer is the light that travels backwards along the squeezed light injection path. After being amplified by the nonlinear process inside the optical parametric oscillator (OPO), the backscattered light eventually reaches the readout photodiode of the interferometer with a random phase, thus adding noise. A control scheme can be implemented to lock the phase of the backscattered light to the pump field of the OPO, in order to obtain a de-amplification of this bright field inside the cavity. The control scheme has been successfully implemented at GEO600, and has proven to have a significant impact on maintaining a high level of squeezing. Due to the fact that there are almost no observable differences between the influence of phase noise and backscatter noise in the squeezing level degradation, the control scheme can be used to decouple the two contributions in the characterisation process of the squeezing injection performance, thus obtaining a more faithful estimation of the actual phase noise that affects the squeezing level.

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