SHG (532 nm)-induced spontaneous parametric downconversion noise in 1064-nm-pumped IR upconversion detectors

As a novel technique for infrared detection, frequency upconversion has been successfully deployed in many applications. However, investigations into the noise properties of upconversion detectors (UCDs) have also received considerable attention. In this Letter, to the best of our knowledge, we present a new noise source—second-harmonic generation (SHG)-induced spontaneous parametric downconversion—experimentally and theoretically shown to exist in short-wavelength-pumped UCDs. We investigate the noise properties of two UCDs based on single-pass 1064-nm-pumped periodically poled LiNbO3 bulk crystals. One UCD is designed to detect signals in the telecom band and the other in the mid-infrared regime. Our experimental demonstration and theoretical analysis reveal the basic properties of this newly discovered UCD noise source, including its dependence on crystal temperature and pump power. Furthermore, the principle behind the generation of this noise source can also be applied to other UCDs, which utilize nonlinear crystals either in waveguide form or with different bulk materials. This study may also aid in developing methods to suppress the newly identified noise in future UCD designs.

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