"Enhanced Optical Resolution with Phase-Sensitive Preamplification"

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The resolution of an optical imaging system is intrinsically tied to the signal-to-noise ratio (SNR) of the detected signal. Maximum achievable resolution depends on the amount of spatial information lost at the image plane across all spatial frequencies. Some of the lost resolution can be recovered by spatially-broadband optical preamplification to bring the signal level above the detecting pixels' noise floor. The achievable SNR and hence the ultimate resolution depends on the type of optical preamplifier used. Phase-sensitive amplifiers (PSAs) are capable of providing noise-free signal gain that can out-perform phase-insensitive amplifiers in SNR by 3 dB at large gains [1,2]. A spatially broadband signal such as that from a LADAR can also be noiselessly amplified with a PSA [3,4]. However, the connection of the improved SNR with resolution enhancement has not been previously explored experimentally. Here we demonstrate, for the first time to our knowledge, enhanced resolution in image detection by use of a PSA. We show that in a one-versus-two-target experiment, images that are otherwise unresolved can be distinguished with higher probability after phase-sensitive amplification than is possible without amplification.

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