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Randomness in the scattering of light by sound[1] TOBEY THORN, ENRIQUE MANZANO, JUAN CORREA, JOHN THOMPSON, DePaul University
— In our experiments, we study the process of a laser passing through a glass optical fiber and scattering off of high frequency sound waves in the glass. The sound waves are created by random thermal fluctuations of silica molecules, and this randomness is passed onto the scattered light which has a complex intensity profile even though the original laser pulses are quite regular in shape. We study the statistical properties of the scattered waveforms and attempt to find general patterns in the random intensity fluctuations of the scattered light. In our experiments, we use a stable single-mode laser system to ensure that there is no significant source of randomness aside from the thermal fluctuations that generate the sound waves. We use a fast detection system, with a resolution of a few hundred picoseconds, to collect thousands of scattered waveforms. We then analyze the data to determine the size of the fluctuations and the probability distribution of the energy contained in the scattered waveforms. We have learned that the relative noise (standard deviation/mean) varies with the amount of the scattered waveform that is integrated. We also observe extremely narrow intensity spikes at the trailing edge of the depleted laser pulses that differ in frequency from the original laser pulse and the highly irregular scattered waveforms.

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John Thompson
DePaul University

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