**Counter-Propagating Coherent Stimulated Raman Spectroscopy for Remote Sensing in Air**


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We analyze phase-matching conditions in various four-wave mixing schemes for coherent nonlinear optical spectroscopy in the counter-propagating beam configuration. Coherent stimulated Raman spectroscopy satisfies the conditions and gives a signal containing specific molecular spectroscopic information. A counter-propagating broadband and a narrowband pulses are used to measure the Raman spectrum with a single shot. In addition, the non-resonant background due to the non-degenerate four-wave mixing is suppressed. Using this technique, we develop a new scheme for standoff spectroscopy in atmosphere by using nitrogen molecules in air as a gain medium for remote lasing.

![Energy Level Diagram](Energy Level Diagram of the SRS process. The 720 nm and 805 nm pulses counter-propagate through the sample region. Either the depletion in the 720 nm pulse or the enhancement in the 805 nm pulse can be measured.]

**References**