

Quantum Correlations of Counter-Propagating Fields in Coherent Raman Medium

R Ooi¹

¹*Department of Physics, Faculty of Science, Universiti Malaya, Kuala Lumpur, Malaysia.*

Contact Phone: +60169632460

Contact Email: rooi@um.edu.my

We have developed a full quantum Heisenberg-Langevin framework of co- and counter-propagating Stokes and anti-Stokes quantum fields in double Raman four-wave mixing parametric oscillators with noise operators. General analytical solutions of the fields operators at any point in the Raman medium are obtained for two counterpropagating (backward) Stokes and anti-Stokes. We analyze the nonclassicality of two-photon correlation functions, spatial variations of the quantum fields, and the two-mode relative intensity squeezing. The results of forward and backward cases for several limiting double Raman schemes are compared. Interesting resonances are found that depend on medium length, laser detunings and laser field strengths (Rabi frequencies) for backward-propagating geometries.

Analysis of the solutions provide insights on the resonant conditions while computation over multiple variables enables us to identify the values of laser detuning, field strength, and propagation length that give enhanced nonclassical intensity squeezing and persistent correlations. This work sets the crucial foundations for optimization of the nonclassicality of photons and would be useful for quantum information and quantum nonlinear optics.