Temporal Quantum Correlation in Inelastic Light Scattering from Water

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Water is one of the most prevalent chemicals on our planet, an integral part of both our environment and our existence as a species. Yet it is also rich in anomalous behaviors. Here we reveal that liquid water is a novel - yet ubiquitous - source for quantum correlated photon pairs. The photon pairs are produced through Raman scattering, and the correlations arise from the shared quantum of a vibrational mode between the Stokes and anti-Stokes scattering events. We confirm the nonclassical nature of the produced photon pairs by showing that the cross-correlation and autocorrelations of the signals violate a Cauchy-Schwarz inequality by over five orders of magnitude. The unprecedented degree of violating the inequality in pure water, as well as the well-defined polarization properties of the photon pairs, points to its usefulness in quantum information.

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