Photonic Platform Based on Squeezed Vacuum States for Molecular Vibronic Spectroscopy

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Quantum chemistry faces challenges in understanding complex electronic structures of atoms and molecules. Molecular vibronic spectra generation, an important tool for analyzing chemical components and studying molecular structures, is computationally demanding. Quantum simulation offers a promising solution, but computing vibronic spectra for large molecules remains difficult. We propose a new algorithm using squeezed vacuum states coupled to a linear optical network. Our integrated quantum photonic chip accurately simulates molecular vibronic spectra with high fidelity. Molecular vibronic spectra of formic acid and thymine were accurately simulated using the integrated chip with high reconstructed fidelity ($>$91%). Also, we successfully simulate naphthalene, phenanthrene, and benzene under non-Condon approximation.