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Quantum Process Tomography of a Room Temperature Optically-Controlled Phase Shift[1] CONNOR KUPCHAK, SAMUEL RIND, EDEN FIGUEROA, Stony Brook University, STONY BROOK UNIVERSITY TEAM — We have developed a room temperature setup capable of optically controlled phase shifts on a weak probe field. Our system is realized in a vapor of ^{87}Rb atoms under the conditions of electromagnetically induced transparency utilizing a N-type energy level scheme coupled by three optical fields. By varying the power of the signal field, we can control the size of an optical phase shift experienced by weak coherent state pulses of $\langle n \rangle \sim 1$, propagating through the vapor. We quantify the optical phase shift by measuring the process output via balanced homodyne tomography which provides us with the complete quadrature and phase information of the output states. Furthermore, we measure the output for a set of states over a subspace of the coherent state basis and gain the information to completely reconstruct our phase shift procedure by coherent state quantum process tomography. The reconstruction yields a rank-4 process superoperator which grants the ability to predict how our phase shift process will behave on an arbitrary quantum optical state in the mode of the reconstruction. Our results demonstrate progress towards room temperature systems for possible quantum gates; a key component of a future quantum processor designed to operate at room temperature.

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Connor Kupchak
Stony Brook University

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