OFFICIAL ABSTRACT and CERTIFICATION

Integrated Optical Setups for Characterizing and Stabilizing Polarization States of Light

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The ability to stabilize light polarization states initiates the development of optical technologies which will yield tremendous societal impacts. Multiple platforms aimed to control the state of polarization have been proposed but lack stability and tunability for experimental implications. This study developed a polarization stabilizer that is easily constructed and operated to precisely measure and retain polarization states. Light pulses were produced using independent Acousto-Optic Modulator and Electro-Optic Modulators units, where an applied voltage (0-500V) encoded a desired polarization state on the probe pulses. Photon polarization characterization incorporated a Quarter-Wave Plate (QWP), Linear Polarizer, and Detector (standard Si-photodetector/Single Photon Counting Module). Stokes Parameters of light were evaluated via a Fourier transformation and best-fit curve of the transmitted light intensity/integrated photon counts concerning the QWP angle. To stabilize drifted polarization, a 4x4 Mueller matrix determined the required angles for a QWP and half-wave plate (HWP) setup, where Sout = M2*M1*Sin. The experimental S1 parameter output for H and V were stabilized to 0.9234 and -0.8934, respectively. The experimental S2 parameter output for D and A were 0.9095 and -0.8727, respectively. Experimental verifications rendered precision and accuracy of the stabilized polarization. This study developed a polarization stabilization system that could be applied in fabricating optical technologies. Future works include incorporating optical detection signals to characterize and stabilize light simultaneously.

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