

FY 27/28 DAGSI Research Topic

1. Research Title: Quantum Entanglement of Photonic States to Advance Quantum Imaging

2. Individual Sponsor/s:

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3. Academic Area/Field and Education Level: Computational electromagnetics, physics, electro-optics, applied physics, electrical engineering (MS or PhD)

4. Objectives: This research investigates the integration of photonic states with orbital angular momentum (OAM) entanglement to advance quantum imaging technology. The conventional imaging techniques using plane-wave or fundamental gaussian beam can be enhanced by OAM light which introduces a new physical dimension that improves the imaging process.

5. Description: In classical interferometry, the spatially dependent interference pattern of two coherent beams, the reference beam and the object beam, after interaction with the object, are recorded and used to construct the interference pattern or hologram of the object. Alternatively, in quantum interferometry, two-photon states that can be generated by spontaneous parametric down-conversion (SPDC) are implemented in one of the two sources. The spatial shape of the object, which is transferred to the spatial shape of the light reflected/transmitted from the object, is contained in the probability amplitudes, corresponding to the paired photons being generated in either of two SPDC sources. OAM entanglement is aiming to surpass the diffraction limit of conventional imaging systems using quantum entanglement or squeezed light, leading to clearer images, especially in low-light condition. The theoretical and experimental analysis will also be applicable to other frequency conversion processes, for instance, sum frequency generation and difference frequency generation, and may also be generalized to the quantum regime for single photons. This work is also aiming to utilize computational capabilities such as advanced artificial intelligence to minimize noise and phase disturbances, to enhance the information in imaging.

6. Research Classification/Restriction: Not Classified/Not restricted

7. Eligible Research Institutions

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