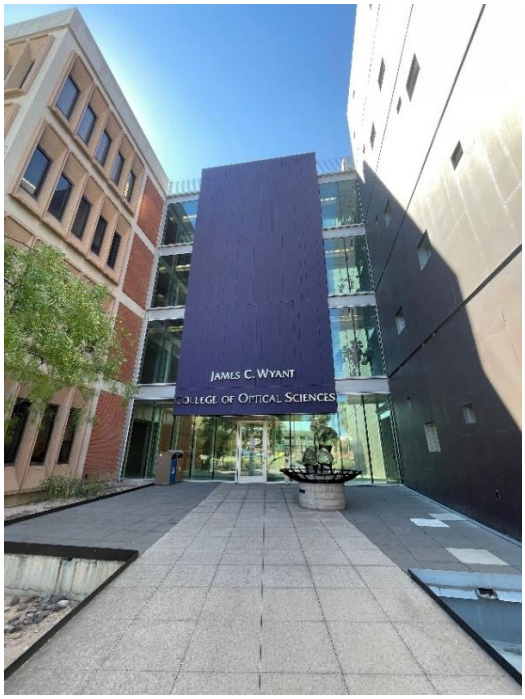
David Fleming-Brown Travel Scholarship Report

I am Khaled Kassem, a 3rd-year PhD student at the School of Physics & Astronomy, University of Glasgow, in the Extreme Light research group. In 2023, I was granted the David Fleming-Brown Travel Scholarship. This scholarship made it possible for me to go to the James C. Wyant School of Optical Sciences at the University of Arizona, Tucson. This trip would prove to be instrumental in my ongoing research journey, providing me with an extraordinary opportunity to collaborate with experts and gain first-hand experience.

My research is all about using some clever tricks with light to make better pictures. At the core of it lies the utilization of second-order (g2) correlations of intensities in an interferometer configuration. This can be considered to be the classical counterpart of the quantum optics effect discovered by Hong, Ou and Mandel. My primary focus is applying this technique to microscopy of translucent biological samples. This research aims to measure changes in optical path length, revealing the hidden structures and topology within these samples. The significance of this work lies in its robustness against disturbances, such as vibrations that could alter the measurement. By harnessing this technique, we demonstrated a robust way to measure the topology of red blood cells accurately. Moreover, by exploring the temporal and spectral domains, our research shows the significant improvement in resolution. Our key tool in achieving this is the synthetic wave, constructed by correlating light of two lasers of different wavelength. This synthetic wave, is

solely constructed computationally and due to our detection technique is also resistant to phase disturbances.

The beauty of this approach is its flexibility, allowing us to select two wavelength bands that, in turn, dictate resolution and range. By pushing these boundaries we were able to demonstrate nanometer dpeth resolution. Furthermore, we can expand on the spectral domain to offer comprehensive sample characterization without requiring a mechanical temporal delay scan.



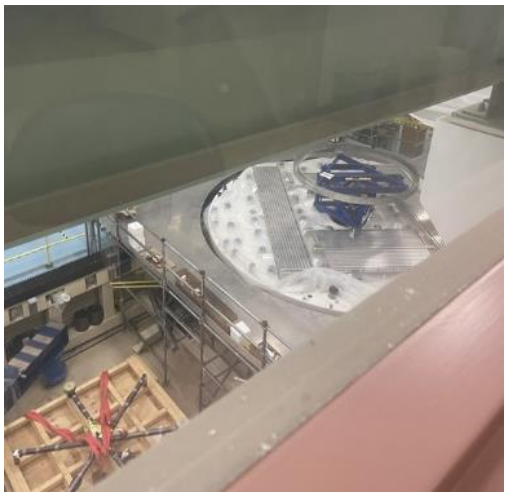
Details of My Visit:

The journey to the University of Arizona was a product of a collaboration with Ass. Prof. Florian Willomitzer, an expert in synthetic wave holography and non-line-of-sight (NLOS) imaging at the Wyant College of Optical Sciences, University of Arizona. My research trip spanned from mid-August to mid-September 2023, offering a condensed period of intensive research and experimentation. Our primary goal was to fuse our robust detection technique for generating synthetic wave holograms with Florian's approach and reconstruction model for non-line-of-sight imaging. This collaboration aimed to enhance NLOS imaging around a corner and through scatterer and showcasing the capabilities of synthetic waves compared to conventional methods.

Throughout my visit, I conducted intensive research on the generation and backpropagation of synthetic holograms. This accomplishment holds immense promise for both microscopy and NLOS imaging. Our experiments in macroscopic NLOS imaging yielded encouraging results, demonstrating the technology's potential.

The academic and cultural exchange during this visit was equally enlightening. Interactions with Florian Willomitzer were not just professionally enriching but also nurturing new collaborative opportunities and ideas for future research. The exchange of knowledge and ideas was genuinely invaluable.

Moreover, I had the privilege of gaining insights into the groundbreaking research conducted at the Wyant College of Optical Sciences, University of Arizona. Notably, the university is housing huge laboratories for the construction of massive 20-meter diameter mirrors intended for astronomy. The laboratory is located beneath the university's American football stadium.



Impact of the Travel Scholarship:

The scholarship provided me with the tools and experiences to further advance in my academic career. This collaboration with experts in the field has expanded my horizons, enriched my methodologies, and offered fresh insights that will make a significant contribution to my doctoral thesis.

The concentrated research experience reinforced the importance of good preparation and structured work methods. The exposure to the academic environment at the University of Arizona broadened my research capabilities and facilitated a vibrant exchange of innovative ideas that will continue to shape my academic journey.

On a personal level, the journey was not just a professional enhancement but also an adventure in cultural immersion. My time at the University of Arizona broadened my worldview and deepened my appreciation for diverse cultures and academic traditions.

In conclusion, the David Fleming-Brown Travel Scholarship has been a transformative asset in my academic and research journey. I am grateful for this opportunity and experiences gained during this trip and to make meaningful contributions to the field of optical sciences. The scholarship has significantly advanced my research, underscoring the value of collaboration.