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The UK Quantum Technology Hub in Quantum Enhanced Imaging

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Fresnel cone polarimeter: compact broadband polarisation analysis

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Fresnel cone polarimeter - compact broadband polarisation analysis

We are developing a one-shot polarimeter, suitable for broadband operation across the visible and near Infra-red. The device is based on fresnel cone technology, resulting in a compact and robust design with no moving parts.

The characterisation of polarisation is crucial for many optical applications, from laser instrumentation to next generation photonics devices. Polarimeters are used in a wide range of metrology applications including bio-chemical identification in beverage and pharmaceutical industries, stress analysis in glass or plastic, environmental and surveillance monitoring, and even the identification of biomarkers in the exploration of exoplanets.

Conventional polarimeters are based either on spatial or temporal modulation of the analysed signal. The former are often bulky and/or expensive, the latter contain moving parts and their update rate is limited by the physical revolution of optical elements. Most polarimeters are designed for a specific wavelength, and even polarimeters classified as “broadband” tend to fail at processing short pulses with broad spectra.

Our Fresnel cones, in contrast, generate quantum-like correlations between polarisation and angular position, induced by total internal reflection from a conical surface. This mechanism holds across a wide range of frequencies, allowing true broadband operation and hyperspectral polarimetry. Additional benefits of our technology are the opportunity for real-time analysis of dynamic signals, a compact and robust device suitable for applications in environments beyond optics labs, and suitability for high power applications. The device could be further optimised for high-speed operation which would allow real-time analysis of dynamic signals.

The system will be benchmarked in the context of laser characterisation in collaboration with M2lasers, and for biomedical applications together with The Beatson and The Photonics Institute.

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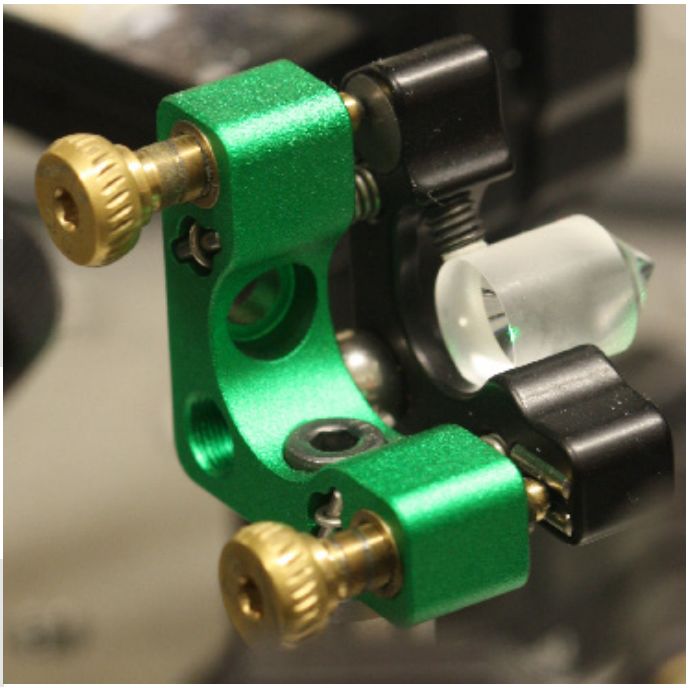

Application area	**Laser characterisation, biomedical ellipsometry, polarimetry in space, material**
Estimated Cost	**From £1k (depending on design specs)**
Specs	**Accuracy of 3mrad, comparable to conventional techniques; broadband operation from visible to near infra- red.**
Latest Publications	**N. Radwell, R.D. Hawley, J. Goette and S. Franke-Arnold, ‘Achromatic vector vortex beams from a glass cone’, Nature Communications 7, 10564, (2016)** **R. D. Hawley, J. Cork, N. Radwell, and S. Franke-Arnold, “Passive broadband full Stokes polarimeter using a Fresnel cone,” Sci. Rep. 9, 2688 (2019).**