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Evaluation of X-ray Imaging Technologies for use at the Extreme Photonics Applications Centre

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The Extreme Photonics Applications Centre (EPAC) at the STFC-Rutherford Appleton Laboratory will be a new facility utilising high intensity laser plasma interactions (LPI) for the generation of ultra-short pulses of ionising radiation. LPI drive sub-picosecond sources of radiation, emitting from an interaction point in the range of 100 nm –100 µm, allowing for high resolution X-ray imaging. With EPAC the laser plasma interaction can deliver 10Hz repetition rate X-ray pulses in the energy range of ˜10-100 keV for betatron interactions, narrowband 1-50 MeV x-ray via inverse Compton scattering, and broadband bremsstrahlung emission up to GeV energies

To fully utilise the properties of LPI sources the imaging detectors will use scintillators lens coupled to high performance CMOS sensors and will be tuned to match the properties of each type of interaction, either betatron or bremsstrahlung/inverse Compton scattering. A high spatial resolution system using ≤100 µm thick YAG:Ce will exploit the high resolution betatron source. A ≥1 mm thick YAG:Ce array will be used for the bremsstrahlung/inverse Compton scattering for high energy >100 keV imaging. We will present the optical test results of large aperture commercially off the shelf lenses, evaluating their performance for imaging these scintillator arrays. The uniformity, resolution, collection efficiency, and veiling glare –a measure the amount of light scatter in the lens, will be presented.

We will also present the results from the characterisation of three scientific grade camera systems for use in these imagers along with X-ray testing of different scintillator materials for resolution, signal level and afterglow.

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