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Detectors for use with high-intensity laser-driven sources of radiation

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High intensity lasers, such as the Vulcan and the Gemini Lasers at the Rutherford Appleton Laboratory, can be used to generate high-intensity ultra-short pulses of energetic radiation. The advent of new high-repetition laser technology, such as DIPOLE, make laser driven radiation a potential source for future science facilities and industrial applications. The characterisation and exploitation of the laser driven radiation sources require specific and customised detector technologies to match the short, repeated pulses of high energy X-rays.
We present results from two detector systems being used to separately measure the spectrum of the emitted x-rays and image the laser source from a single laser shot. The first is a 10cm x 10cm position sensitive energy resolving detector based on the HEXITEC ASIC. The detector is comprised of 25 CdTe sensors arranged in a array with a total of 160k energy resolving pixels that can each measure a single X-ray photon per laser shot and can be combined to give an energy spectrum per shot with <2keV FWHM energy resolution in the 10-200keV range. The second detector is made from 2x2 Lassena wafer scale CMOS monolithic active pixel sensors with an active area of 24cm x 28cm and 27 MPixels. A 1mm thick CsI(Tl) scintillator is mounted directly onto the Lassena sensors to maximise detector efficiency for energies of 100 to 150 keV while maintaining adequate spatial resolution. The sensor operates with a full frame rate of up to 30 fps and is operated in a triggered mode to capture images from single laser shots to image the X-ray beam. We also present potential detector designs based on these technologies that would allow the full range of radiation that can be generated from these laser driven sources to be measured.

Primary authors: Dr BRENNER, Ceri (STFC); Mr ARMSTRONG, Christopher (University of Strathclyde & STFC); Prof. NEELY, David (STFC); Dr RUSBY, Dean (STFC); SEDGWICK, Iain (STFC); WILSON, Matthew (STFC); SELLER, Paul (RAL); RICHARDS, Sion (Science & Technology Facilities Council)

Presenter: RICHARDS, Sion (Science & Technology Facilities Council)

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