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LINEAR-MODE AVALANCHE PHOTODIODE ARRAYS FOR LOW-NOISE NEAR-INFRARED IMAGING IN SPACE

Abstract

Astronomical observations often require the detection of faint signals in the presence of noise, and the near-infrared regime is certainly no exception. In particular, where the application has short exposure time constraints, we are frequently and unavoidably limited by the read noise of a system. A recent and revolutionary development in detector technology is that of electron avalanche photodiode (eAPD) arrays. By the novel introduction of a signal gain layer within the array itself, effective read noise can be reduced to ¡0.2 e-, enabling the detection of very small signals at frame rates of up to 1 kHz. This is already impacting ground-based astronomy in high-speed applications such as wavefront sensing and fringe tracking, but has not yet been exploited for scientific space missions. We present the current status of a collaboration with Leonardo - creators of the Saphira eAPD array - as we work towards the first in-orbit demonstration of a Saphira device in 'Emu', a hosted payload on the International Space Station. The Emu camera will fully benefit from the 'zero' read noise characteristics of eAPD technology as it produces an all-sky drift scan survey in the 1.4 m band, using compact readout electronics developed at the Australian National University. This is one example of a use case that could not be achieved with conventional CMOS sensors. We believe that there are many more.