Contribution ID: **19** Type: **Oral presentation (20 minute)**

FIREBall-2 delta-doped EMCCD for photon starving UV astronomy: modeling, tradeoffs and future upgrades

Wednesday, 13 March 2024 11:25 (25 minutes)

In the pursuit of observing fainter astronomical sources and phenomena, a significant challenge in detector development lies in ensuring these devices can detect each individual photon they receive.
By amplifying each incoming photon by several orders of magnitude, Electron-Multiplying CCDs (EMCCDs), offer a promising solution to meet this challenge.
While these powerful detectors boast impressive potential, they remain highly sensitive, requiring precise optimization and fine-tuning of their parameters to unlock their full capabilities in the photon-starved regime
The Faint Intergalactic Redshifted Emission Balloon (FIREBall-2) is a stratospheric project that aims to detect and map the low surface brightness environment of galaxies in the UV at z~0.7.
As a technology demonstrator for photon starved astronomy and in order to advance the technology readiness level of UV EMCCD, the spectrograph uses an e2v EMCCDs delta-doped by JPL, combined with a Nüvü controller.

To analyze the detector data and retrieve the device noise contributions, we developed an EMCCD comprehensive model along with DS9 analysis tools to compare the model to actual data under very diverse operating conditions.
This allowed us to examine the current performance and limitations of these devices both on the ground and in the stratospheric environment, to unravel the intricacies of these detectors.

In addition, we will discuss the development and implementation of an Exposure Time Calculator (ETC) designed to optimize the end to end Signal-to-Noise Ratio (SNR) under diverse conditions and analyze the different tradeoffs associated with such devices.
This will be used to explore some EMCCD-related issues encountered on FIREBall-2 and present some recent and future upgrade strategies (controller upgrade, red blocking filter, overspill register implementation, etc.) to mitigate them.

contribution subject matter

noise characteristics

Keywords for your contribution subject matter (this will assist SOC in accurately characterizing your contribution)

UV, delta-doped, EMCCD, photon-counting, smearing (CTI)

Primary author: PICOUET, vincent (Caltech)

Presenter: PICOUET, vincent (Caltech)

Session Classification: Detector Models

Track Classification: Major ISPA Workshop Tracks: Detector Modeling