
Contribution ID: **134** Type: **Talk**

# Mitigating Radiation Damage in Photon Counting EMCCDs for the WFIRST Coronagraph: survival in an L2 orbit

*Wednesday 6 September 2017 09:50 (20 minutes)*

The Wide-Field Infrared Survey Telescope (WFIRST) is a NASA flagship space observatory due to launch in the mid-2020s. In addition to probing dark energy and carrying out broad infrared surveys with the Wide-Field Instrument, WFIRST will also image and spectrally characterize extrasolar planets with a coronagraph at an unprecedented level of sensitivity. The faint planet targets require photon counting detectors to meet the stringent signal-to-noise requirements, with a CCD201-20 EMCCD sensor baselined for flight. However, the challenging WFIRST L2 radiation environment must first be considered. Radiation effects in the form of displacement damage from protons can hinder the charge transfer efficiency (CTE) of EMCCDs, as well as affecting dark current and other performance. In order to investigate these effects, we established a photon-counting laboratory at JPL, where we designed and completed a pre- and post-irradiation study of these sensors. Beyond characterization, which also included studies of read out noise, clock induced charge and electron multiplication gain, we discuss techniques we developed to identify damaged regions of the devices and mitigate their effects. Finally, we outline an on-going EMCCD technology development program currently underway between JPL and Teledyne e2v to modify the CCD201-20 for radiation hardness in space.

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**Session Classification:** Detectors for ground and space-based astronomy, planetary and space science (III)