WFIRST AFTA-C: Challenges in direct imaging of ExoPlanets in a harsh radiation environment

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Description:

WFIRST-AFTA is a 2.4m class NASA observatory designed to address a wide range of science objectives using two complementary scientific payloads. The Wide Field Instrument (WFI) offers Hubble quality imaging over a 0.28 square degree field of view, and will gather NIR statistical data on exoplanets through gravitational microlensing. The second instrument is a high contrast coronagraph that will carry out the direct imaging and spectroscopic analysis of exoplanets, providing a means to probe the structure and composition of planetary systems.

The coronagraph instrument is expected to operate in low photon flux for long integration times, meaning all noise sources must be kept to an absolute minimum. In order to satisfy these low noise requirements, the Electron Multiplying (EM)-CCD, designed and manufacture by Teledyne e2v (string collaborators with the CEI) has been baselined for both the imaging and spectrograph cameras. The EMCCD was selected in comparison with other candidates because of its low effective electronic read noise at sub-electron values with appropriate multiplication gain setting, but it has never been flown before and this brings new risks and complications. The presence of other noise sources, however, such as thermal dark signal and Clock Induced Charge (CIC), need to be thoroughly investigated and then reduced and mitigated. In addition, operation within a space environment will subject the device to radiation damage that will degrade the Charge Transfer Efficiency (CTE) of the device throughout the mission lifetime, making single photon counting a new and challenging task.

The CEI has been working with JPL over the past four years through the work of Nathan Bush to quantify the performance of the detector under cryogenic irradiation with standard operating conditions. There is, however, a great deal of further research required to optimise the detector system towards achieving the science goals of the mission. The project is very well aligned with the current main research themes of the CEI and the wider community in radiation damage under cryogenic temperatures.

Qualifications required:

A first class or upper second class MSc/BSc degree in Physics, Electronic Engineering or a related discipline.