WFIRST IR Detectors TAC Report on Milestone #5 Review

A telecon review of Milestone #5 for the WFIRST instrument detector technology program was held on January 17, 2017. Milestone #5 is a continuation of the same H4RG detector development effort characterized by the previous Milestones #1, #2, #3, and #4. The goal for this Milestone was to prove that the intended WFIRST PV3 sensor chip assemblies (SCAs) could withstand the expected thermal, vibrational, and radiational (high energy particle) stresses to be expected during the lifetime of the mission. One PV3 SCA was subjected to thermal and vibrational testing at GSFC, undergoing one "survival cycle" and 40 less stressful thermal cycles, with the latter intended to be roughly twice as many thermal cycles as a SCA is expected to experience in its entire lifetime, from fabrication, though testing and installation, to the end of the prime mission. Vibration testing was also performed on this SCA to a level higher than will be encountered during the mission. Detailed testing of the number of disconnected pixels, CDS noise, gain, dark current, and quantum efficiency (QE) showed entirely negligible differences between the pre-stress and post-stress results. A second PV3 SCA was irradiated in seven steps by 63 MeV protons at UC Davis. A total dose of 5 krad was induced, similar to that expected for JWST (also planned to orbit at L2), though the WFIRST detector array will be shielded more from solar energetic particles and cosmic rays than the JWST cameras [Note that WFIRST will be flying during the next solar maximum.] While the post-irradiation QE testing has not yet been done at the GSFC DCL, the post-irradiation testing accomplished at UC Davis and at GSFC for CDS noise, numbers of noisy and hot pixels, and dark current, all show a rapid decrease to acceptable levels in short periods of time at temperature (including some thermal annealing) following each irradiation step.

The TAC unanimously agrees that the WFIRST team members presented persuasive evidence that the requirements for Milestone #5 have been met, thus completing the final Milestone for this phase of the WFIRST development program, essentially on time.

In our Milestones #2 and #4 reports, the TAC requested to learn more about the effort to understand why measured QE values exceeded the physical bound of 100% for certain devices at certain wavelengths. The TAC is pleased to learn that this problem has now been largely resolved, with the apparently unphysical results having been traced to the AR coatings on the devices and to the baffling employed in the test chamber. On this QE issue, one of us (Judith Pipher) requested to see the Teledyne process evaluation chip (PEC) data for the PV3 SCAs, and it was promised that this data would be provided to her. Also, we assume that that QE testing for the irradiated SCA at the GSFC DCL will turn out to be successful, as expected.

We thank Dave Content, Robert Hill, Jonathan Mah, Augustyn Waczynski, and others for their presentations and comments during the review. We also commend the entire WFIRST and Teledyne team for the successful completion of a rigorous set of Milestones for the WFIRST Detector Program.

WFIRST IR Detectors TAC Members

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