



Kitt Peak Mosaic Upgrade— an Imager for a New Decade of Science

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A project to upgrade the KPNO Mosaic-1 Imager is underway due to the assistance of supplemental funding from the NSF in support of NOAO's Renewing Small Telescopes for Astronomical Research (ReSTAR) proposal (www.noao.edu/system/restar/). The Mosaic-1 upgrade is being led by Project Scientist Steve Howell and Project Engineer Dave Sawyer and carried out collaboratively by staff from the NOAO System Instrumentation program and KPNO. The upgrade will focus on replacement of the now outdated Arcon CCD controllers. New CCD detectors, new controllers, and new software for improved performance, reliability, and serviceability of the instrument are all aspects of the upgrade project. New CCDs are on order and are scheduled to arrive in early April 2010. A review of the project plans and design was held 20 January 2010. A final design review will occur in late March 2010.

The impact to observing with the Mosaic-1 Imager is being minimized as much as possible by scheduling the majority of the upgrade work during the summer months and our annual shutdown during the monsoon season. Mosaic-1 will be taken out of service in mid-June 2010 and sent to Tucson for about three months for the installation of the new detectors and controllers, implementation of new software, and system integration and testing. The upgraded instrument is scheduled to return to Kitt Peak 1 October 2010 to start a commissioning phase that is expected to be completed October 29. Shared risk observing for visiting observers is to be scheduled during the remainder of the 2010B observing semester. Unfortunately, commissioning of the upgraded Mosaic-1 on the WIYN 0.9-m telescope likely will need to wait until a future semester, although we are still studying schedules that would allow us to have an initial technical and engineering run on the WIYN 0.9-m with the new version of the instrument during January 2011. The Mosaic-1 Imager will not be available for science programs at the WIYN 0.9-m telescope during 2010B.

The new detectors will be 2K x 4K pixel format devices fabricated by e2v Technologies and will be arranged in an 8K x 8K array that is nearly identical to the existing focal plane (Figure 1). The detector format was chosen to minimize the impact on science images, such as changes in the field of view and gaps between detectors, but current Mosaic-1 users will see subtle changes in the data after the upgrade. The new detectors will have reduced readout noise, higher frequency operation for reduced readout times, and better quantum efficiency. These improvements in detector performance will reduce both exposure times and readout times, thus, the science data volume is expected to increase significantly. The e2v detectors offer many coating options, and after soliciting comments from Mosaic users, our review panel, and the KP Users Committee, a two-layer coating was selected (Figure 2). The coating was selected because it provides a more uniform exposure depth across the UVBRI band passes, which is beneficial for surveys, and provides a flatter overall response curve, which is generally easier to standardize. The improved blue response of the two-layer coating will also be more complementary to other wide-field imagers to be available through NOAO, such as the Dark Energy Camera.

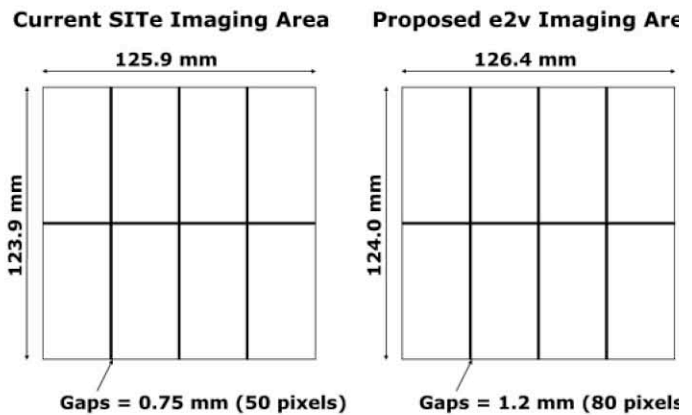


Figure 1: Comparison of imaging area between the current and new Mosaic focal plane arrays

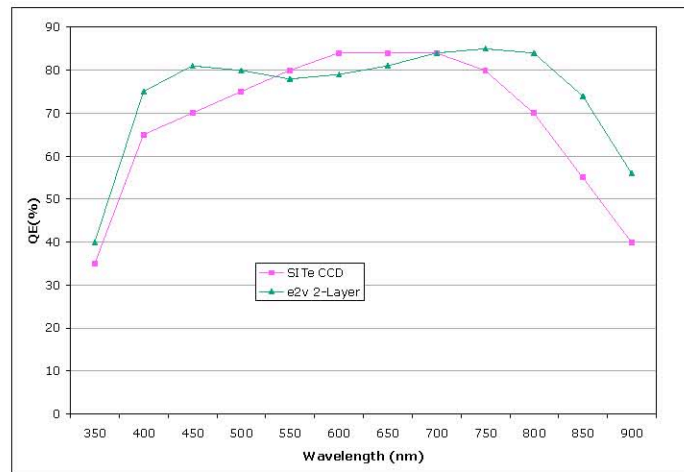


Figure 2: Plot showing the quantum efficiency of the e2v CCD with a two-layer anti-reflective coating relative to the existing SITe CCDs in Mosaic-1.

As part of the upgrade, the aging Arcon CCD controllers will be replaced. Many components used in the Arcon controllers are no longer available and spare parts have been depleted, which makes the controllers very difficult to support. In addition, there has been an increase in failures due to the aging components that has adversely affected the reliability and efficiency of the instrument. The controllers will be replaced with modern MONSOON TORRENT controllers. TORRENT is the next-generation MONSOON controller, which is currently in development and expects to reach production readiness in May 2010. TORRENT shares a lot of technology with the previous MONSOON "Orange" controllers in order to reduce development risk, while components have been updated to improve parts availability and power consumption.

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The user interface and user software will also have to be changed as part of the upgrade project. Currently Mosaic-1 is run with an IRAF Control Environment (ICE) Arcon package as well as a few independent graphical user interfaces that control specific features of the instrument/telescope combination. Given the success of the NEWFIRM wide-field infrared imager's user interface and control system (NEWFIRM Observation Control System, NOCS), we plan to adapt it for the new Mosaic-1 user interface. There are many advantages with choosing NOCS, but the primary reason is that it has had two years of use at the Mayall telescope and users and support personnel now have valuable experience using this system. This has allowed the software to be debugged and optimized.

NOCS also has been well-documented by the NOCS team. Currently, NOCS includes 90% of the functionality required to operate the new

Mosaic-1 instrument. The new user interface will contain all of the current functionality as well as some improvements, such as the ability to try it at home prior to your run and to make and use observing scripts.

If you have questions regarding the upgrade, please contact the project scientist at howell@noao.edu. Questions regarding the scheduling of shared-risk programs should be directed to KPNO Director Buell Jannuzi (bjannuzi@noao.edu). For more information on the Mosaic-1 upgrade project see www.noao.edu/ets/mosaic.

