What are Orthogonal Transfer CCDs Good for Anyway?

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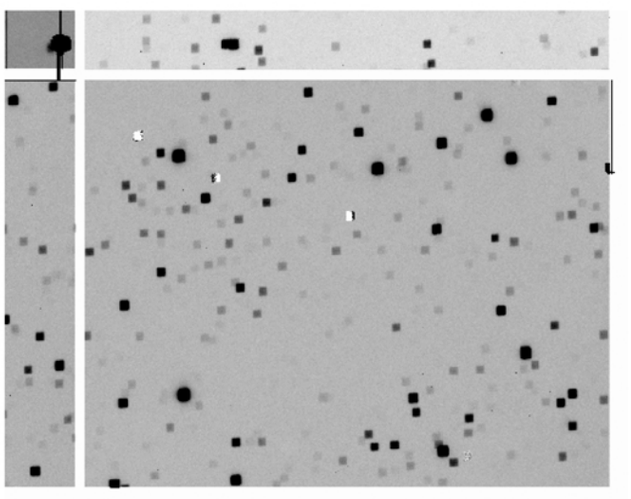
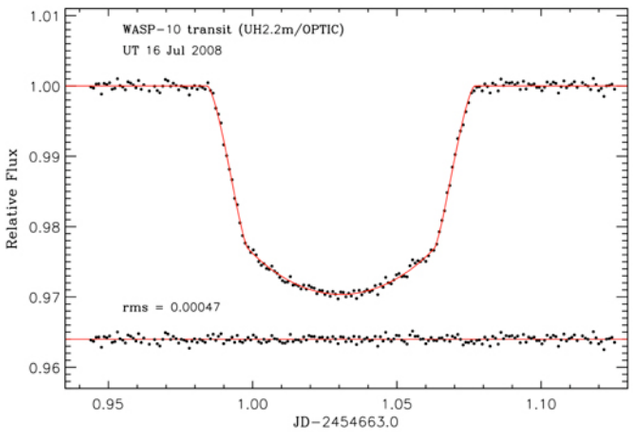
Kitt Peak National Observatory is home to the first general-use orthogonal transfer CCD (OTCCD) camera. The Orthogonal Parallel Transfer Imaging Camera (OPTIC) has been in service at the WIYN Observatory for over five years now, spending nearly half the time on Kitt Peak and half the time on Mauna Kea at the University of Hawai′i 88-inch telescope. OPTIC was built by John Tonry (University of Hawai′i) and makes use of the new OTCCDs developed by Tonry in collaboration with Massachusetts Institute of Technology Lincoln Labs. Originally developed as a means to provide low-order tip/tilt corrections through the use of one or more bright guide stars, OTCCDs have been used for a number of other purposes. Their performance as tip/tilt imagers equals that of low-order mechanical systems, albeit easier to set up and use. There are no moving parts—the collected electrons are merely moved during integration to follow the atmosphere.

One of the most promising uses of OTCCDs, as demonstrated by OPTIC both at WIYN and at the University of Hawai′i 88-inch telescope, is for the collection of ultra-high-precision, high-speed photometry. Since OTCCDs have the ability to move the collected charge during an active exposure, Howell et al. (2003, PASP, 115, 1340) put this idea to work in the form of purposely forming square stars in the image (see below).



The idea was to collect as many photons as possible without saturation as well as form a very stable point spread function. All stars in the image are formed into the same shape, and extracting differential photometry of the stars of interest leads to the elimination of almost all systematic and atmospheric effects, producing the highest ground-based photometric precision routinely obtainable. A striking example of such work is the light curve of the transiting exo-planet WASP-10 obtained by Johnson et al. (2008, *adsabs.harvard.edu/abs/2008arXiv0812.0029J*). The graph below shows the transit light curve and the amazing precision obtained, rms = 0.00047 magnitude.



So why are we showing off OTCCDs? Well, if you have not heard, the WIYN Observatory is about one year away from beginning the commissioning of a one-degree imaging camera that will contain OTCCDs as the detectors. Imagine the potential of the One Degree Imager if such high-precision, time-series photometry could be gathered all at once over a one-degree field of view. Open clusters and planet searches come to mind right away, but many additional scientific projects will be enabled as well.

Further information on OTCCDs at WIYN can be found in the December 2008 *Newsletter* article "QUOTA—A Prototype Camera for the WIYN One Degree Imager" and in this issue's "WIYN's One Degree Imager: About a Year to the Start of Commissioning."