
Enabling high resolution visible AO at the W.M. Keck Observatory

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Abstract

The W. M. Keck Observatory, in response to community workshops led by the Keck Adaptive Optics (AO) Future Study Group, has identified visible AO as an attractive science path for the observatory. Given the 10-meter aperture of the Keck telescopes, a visible AO system can achieve extremely high spatial resolutions. In collaboration with the National Aeronautics and Space Agency (NASA) the observatory recently installed a visible camera (ORKID) that works behind AO as part of the Orbiting Configurable Artificial Stars (ORCAS) mission. ORCAS is a first-of-its-kind hybrid space and ground observatory, using a satellite-based laser as the AO beacon for wavefront sensing. The ORKID camera is currently used in lucky imaging mode, while the AO system locks on a natural guide star. The intent is to use the camera for long integrations after upgrading the AO system with a higher order deformable mirror and to use the satellite-based laser as the AO beacon. With this camera we have imaged the close binary Theta Orionis C, in a Hydrogen-Alpha narrowband filter (650-660nm). The binary is detected with an intensity ratio of 6.3 to 1, and at a separation of 44.4 mas. This separation is roughly equivalent to the full-width at half-maximum (FWHM) of a K-band ($\sim 2.2\mu\text{m}$) point spread function (PSF), making it difficult to resolve the two components at longer wavelengths. With the FWHM of this image at 15.1 mas, this is the sharpest PSF ever measured at Keck demonstrating the potential offered by visible AO. We present results from ORKID and our development plans for visible AO moving forward

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