
AO3K at Subaru: the facility adaptive optics goes extreme

Julien Lozi^{*1}, Kyohoon Ahn¹, Masayuki Akiyama², Alicia Chun³, Christophe Clergeon⁴, Vincent Deo¹, Olivier Guyon¹, Takashi Hattori¹, Yosuke Minowa¹, Yoshito Ono¹, and Sebastien Vievard¹

¹Subaru Telescope – United States

²Tohoku University [Sendai] – Japan

³University of Chicago – United States

⁴Gemini Observatory – United States

Abstract

The facility adaptive optics of the Subaru Telescope AO188 is getting some long-awaited upgrades: a new 3224-actuator deformable mirror from ALPAO (hence the name change to AO3K), an upgraded GPU-based real-time computer, a non-linear curvature wavefront sensor and a near-infrared wavefront sensor (NIRWFS) using First Light Imaging's C-RED ONE camera, closing the loop at up to 2 kHz. With these new features, AO3K will provide extreme-AO level of correction to all the instruments on the IR Nasmyth platform: The NIR-MIR camera and spectrograph IRCS, the high-resolution Doppler spectrograph IRD, and the high-contrast instrument SCExAO. AO3K will also support laser tomography (LTAO), delivering high Strehl ratio imaging with large sky coverage.

The NIRWFS, using part of the light from y- to H-band, will dramatically increase the number of reachable targets for high-contrast imaging, for exoplanets characterization, as well as AGNs or the galactic center. It has two modes that can be used to drive the new DM: A double roof-prism pyramid WFS, and a focal plane WFS.

The high Strehl will especially benefit SCExAO for high contrast imaging. The second stage ExAO will no longer have to chase large residual atmospheric turbulence, and will focus on truly high contrast techniques to create and stabilize dark holes, as well as coherent differential imaging techniques. We will finally be able to leverage the several high performance coronagraphs tested in SCExAO, even in the visible.

AO3K will answer crucial questions as a precursor for future adaptive optics systems for ELTs, especially as a technology demonstrator for the HCI Planetary Systems Imager on the Thirty Meter Telescope. A lot of questions are still unanswered on the on-sky behavior of high actuator counts DMs, NIR wavefront sensing, the effect of rolling shutters or persistence.

We present here the first lab and on-sky results of AO3K, giving us some insight on the great scientific results we hope to achieve in the future.

^{*}Speaker

Keywords: NIR wavefront sensor, extreme adaptive optics, non, linear curvature wavefront sensor, high, contrast imaging