Status of the SCExAO platform - a multi-purpose instrument, testbed, and technological demonstrator for high-contrast imaging.

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Abstract

The Subaru Coronagraphic Extreme Adaptive Optics platform (SCExAO) is a high-contrast imaging (HCI) instrument, installed since 2009 at the Subaru 8.2-m telescope. SCExAO's uniqueness lies in its loosely constrained and highly versatile design, allowing the platform to be used as an instrumental research testbed, as well as an active, science-producing HCI instrument open to the international community. Several scientific and technical modules are deployed within SCExAO, allowing diverse operational configurations, e.g. up to eight cameras simultaneously sharing astronomical light from 400 nm to 2.2 μm for imaging, spectroscopy, and wavefront sensing.
At the front-end, SCExAO benefits from a first-stage wavefront correction from the facility AO system, which is currently being upgraded from a 188 actuator correction to a 3224-element DM (AO3K), along with a high-order infrared pyramid wavefront sensor (WFS) and visible light quad-plane curvature WFS, which will enable a high-Strehl beam and to repurpose SCExAO's internal correction only towards HCI features, such as dark-hole digging and coherent differential imaging. The deployment of AO3K's real-time computer will facilitate joint integration with existing WFSs in SCExAO and enable, together with other efforts in sensor fusion and predictive control, a tighter integration to achieve the deepest possible contrasts.

At the back-end, we present upgrades to the visible light polarimetric imager VAMPIRES, being redesigned using sub-electron noise CMOS cameras and with multi-band imaging modes, equivalent to a low-resolution, polarimetric IFU. The pupil-remapping interferometric modules FIRST and GLINT leverage the high-Strehl correction to provide high-value sub-diffraction-limit astrophysical measurements, and also pave the way into the world of astrophotonics. We also present recent results from already commissioned modules: the NIR spectro-imager CHARIS, the fast NIR polarimetry, and the MKIDS exoplanet camera.
The SCExAO team encourages collaborators and is always willing to share the exceptional availability of the platform for technological demonstrations. Looking towards the future, as science modules and wavefront control techniques reach full maturity, SCExAO, AO3K,

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and their neighbor instruments at Subaru telescope (IRCS, IRD) are envisioned to together become a complete system-level demonstrator for the Planetary Systems Imager, the future high-contrast platform of the Thirty Meter Telescope, which resolution will allow groundbreaking improvements in high-resolution, high-contrast astronomy.

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