Design, Integration and Tests of SPIDERS: a Subaru Pathfinder Instrument for Detecting Exoplanets & Retrieving Spectra

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Abstract

SPIDERS is a Subaru Pathfinder Instrument for Detecting Exoplanets and Retrieving Spectra. This visitor instrument is currently integrated and tested at NRC-HAA before shipping to Subaru Telescope scheduled later this year. SPIDERS will be installed on the infrared Nasmyth platform of Subaru behind the newly upgraded AO3k system and the new Beam Switcher mechanism. The telescope beam can be either shared between SPIDERS and SCExAO for simultaneous observations during engineering runs, or sent entirely to only one instrument for doing science.
SPIDERS is a pathfinder for GPI 2.0 CAL update and also for future Adaptive Optics (AO) instruments on Extremely Large Telescopes. The optical layout of SPIDERS is very compact and can be adapted to work behind virtually any future AO facilities, such as NFIRAOS on TMT, or MORFEO on E-ELT, either as a focal-plane wavefront sensor sending offset commands to the main AO loop, or as a stand-alone second-stage AO instrument.
SPIDERS is based on the Fast Atmospheric Self-Coherent Camera (SCC) Technique (FAST) that can enhance the contrast up to 100 times. The key-components are an ALPAO DM468 used as a second-stage AO corrector, a pupil apodizer mask, a Tilt-Gaussian Focal Plane Mask (FPM), a reflective Lyot stop feeding two cameras. The transmitted light feeds a First Light Imaging C-RED2 camera imaging a 5" FoV in narrow bands and acting as a SCC focal plane wavefront sensor and as a science imager. The blocked light is reflected to a Low-Order Wavefront Sensor complementing the SCC wavefront sensing. In addition, a beam-splitter located on the SCC path feeds an imaging Fourier-Transform Spectrograph and a SAPHIRA camera for spectroscopy up to R_˜20,000 over a 3.3" FoV. This paper will present the overall opto-mechanical design, along with the integration steps and preliminary lab test results.

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