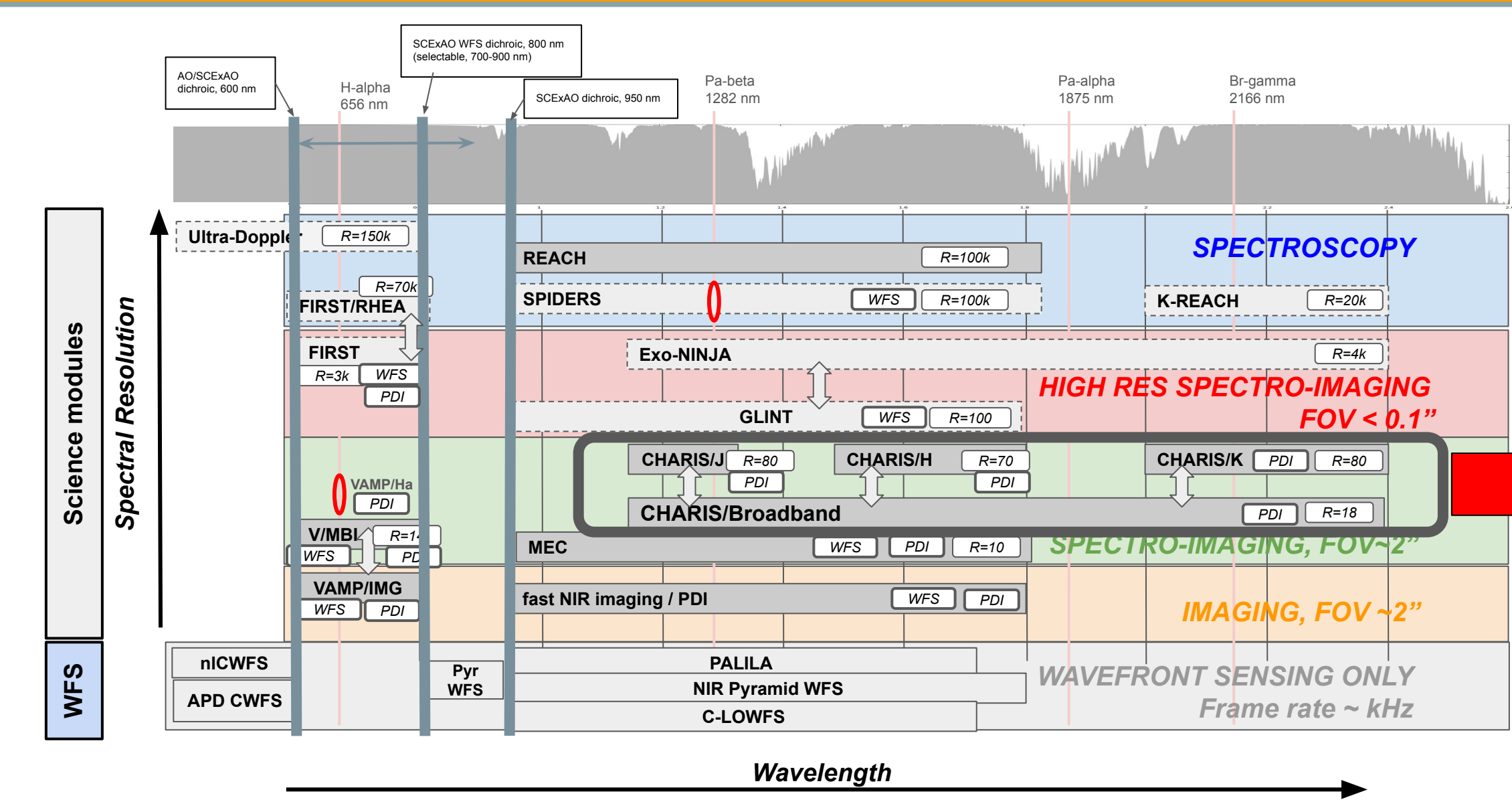
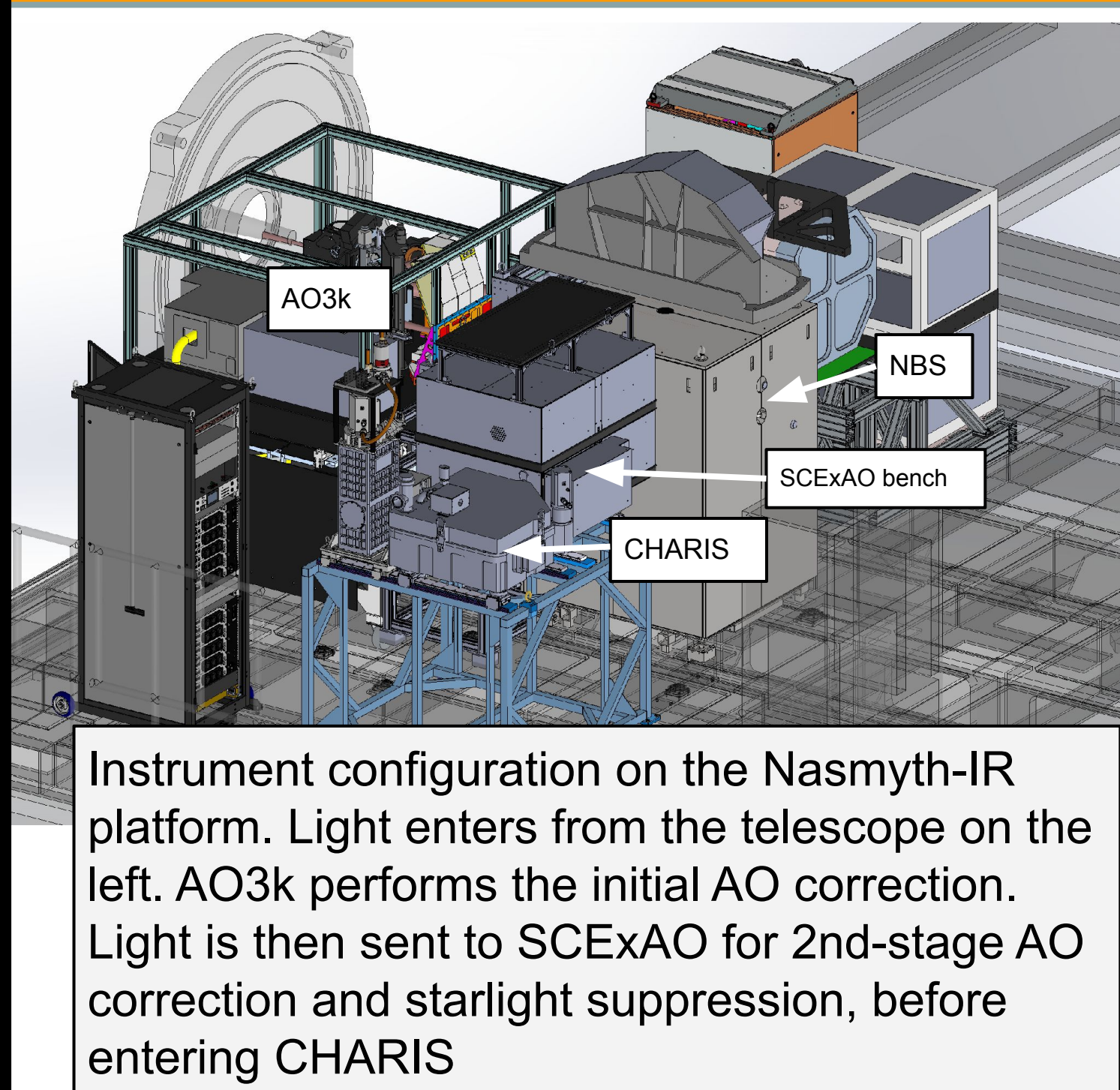
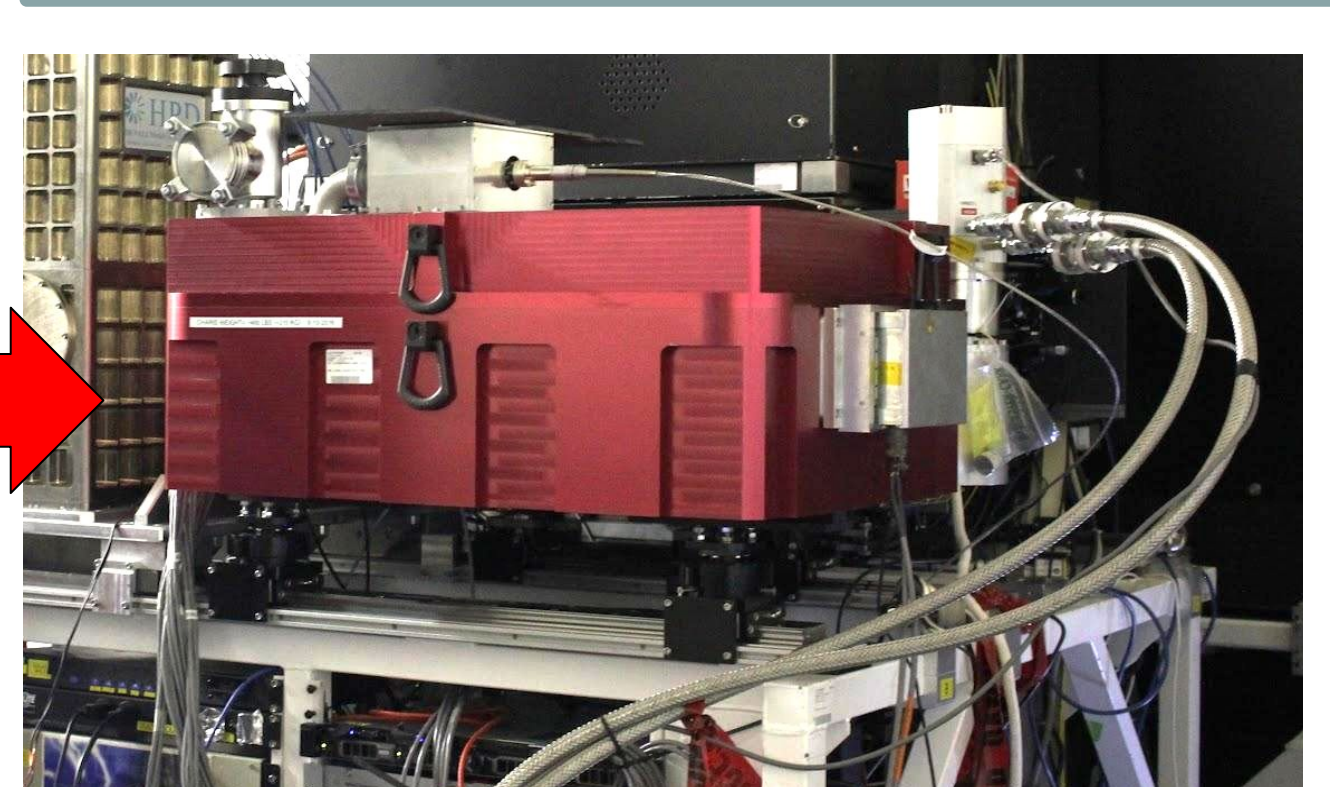


INTRODUCTION TO SCEXAO & CHARIS



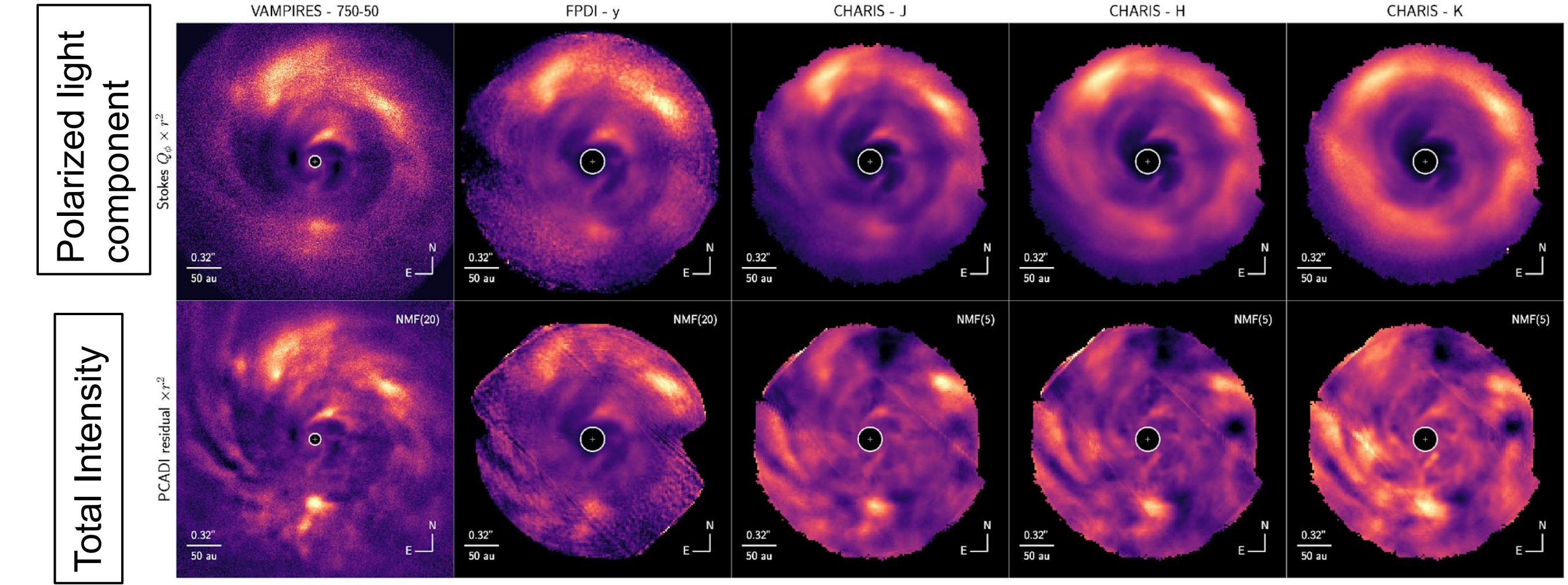
CHARIS



Current and future instrument modules, as a function of wavelength (x-axis) and spectral resolution (y-axis). Many modules can operate simultaneously. See posters P28, P29, P30, P31 and P33 for details.

CHARIS is the main SCEXAO science instrument, operating in nearIR at spectral resolution ranging from 20 to 70. FOV 2.07" x 2.07%

Instrument configuration on the Nasmyth-IR platform. Light enters from the telescope on the left. AO3k performs the initial AO correction. Light is then sent to SCEXAO for 2nd-stage AO correction and starlight suppression, before entering CHARIS



SCEXAO provides a broad range of measurement capabilities to study exoplanet and disks. In this example, the AB Aur disk was observed from visible to NIR. From left to right:

- VAMPIRES @ 750nm (one of 4 bands available)
- fast-PDI in y band
- CHARIS in J, H and K bands (raw data has 20 bands)

Each of the 3 instruments was used in PDI mode: PDI shown at the top, total intensity in the bptpm. All measurements obtained with coronagraph.

AB Aur, data reduction: M. Lucas All data captured *simultaneously*

CHARIS MODES

Spectroscopy

LOW RESOLUTION MODE:

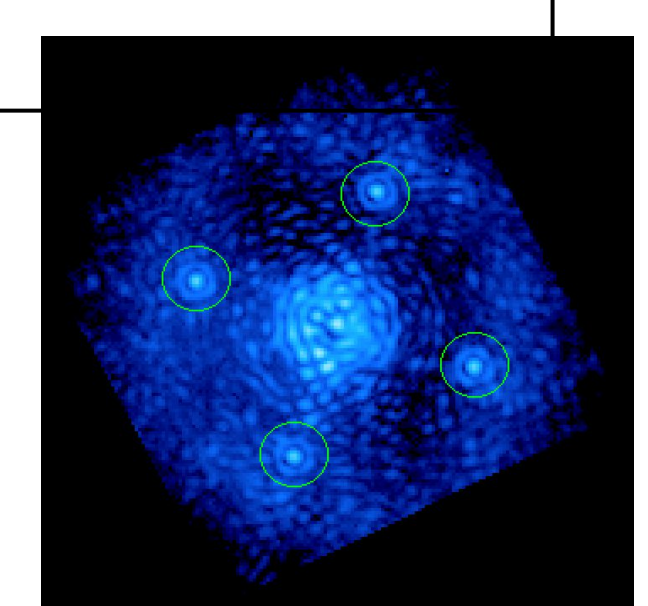
- R~19, J+H+K Band
- 65-70% instrument throughput
- 10-15% from atmosphere to detector

HIGH RESOLUTION MODE:

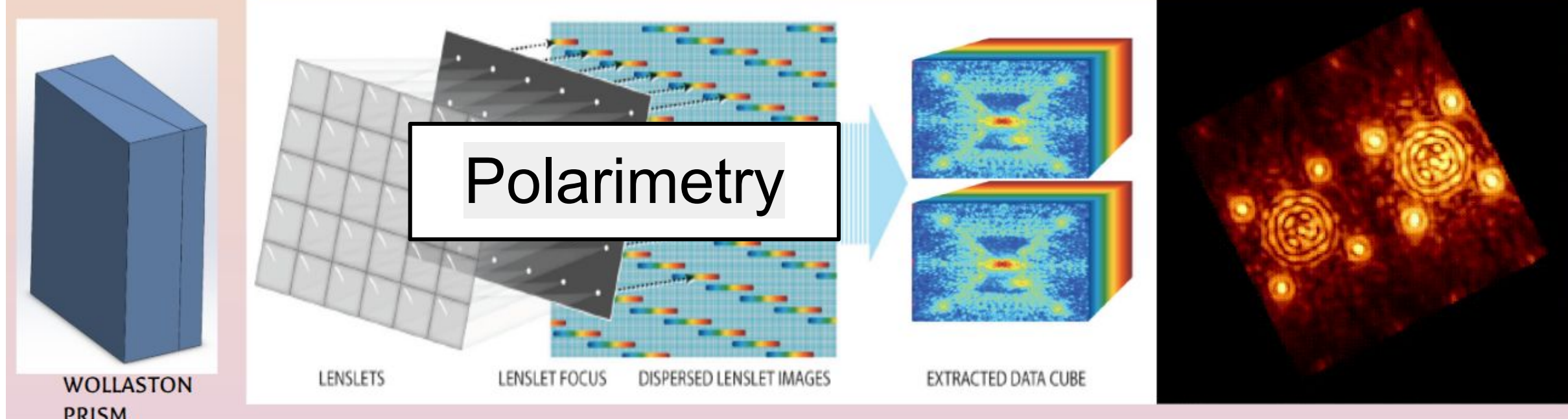
- R~70-90: J, H, and K Bands
- 55-60% instrument throughput
- ~15% from atmosphere to detector

Coronagraphy

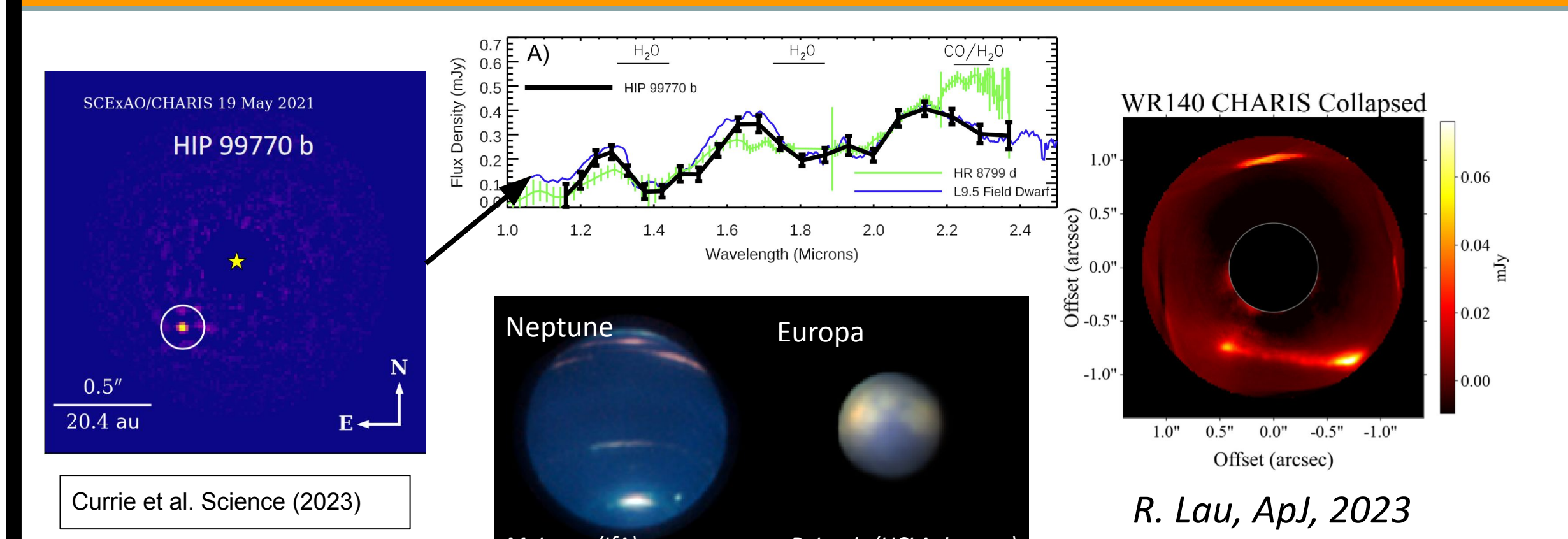
- Selectable Lyot focal plane mask
- Optional astrogrid for PSF referencing



Polarimetry



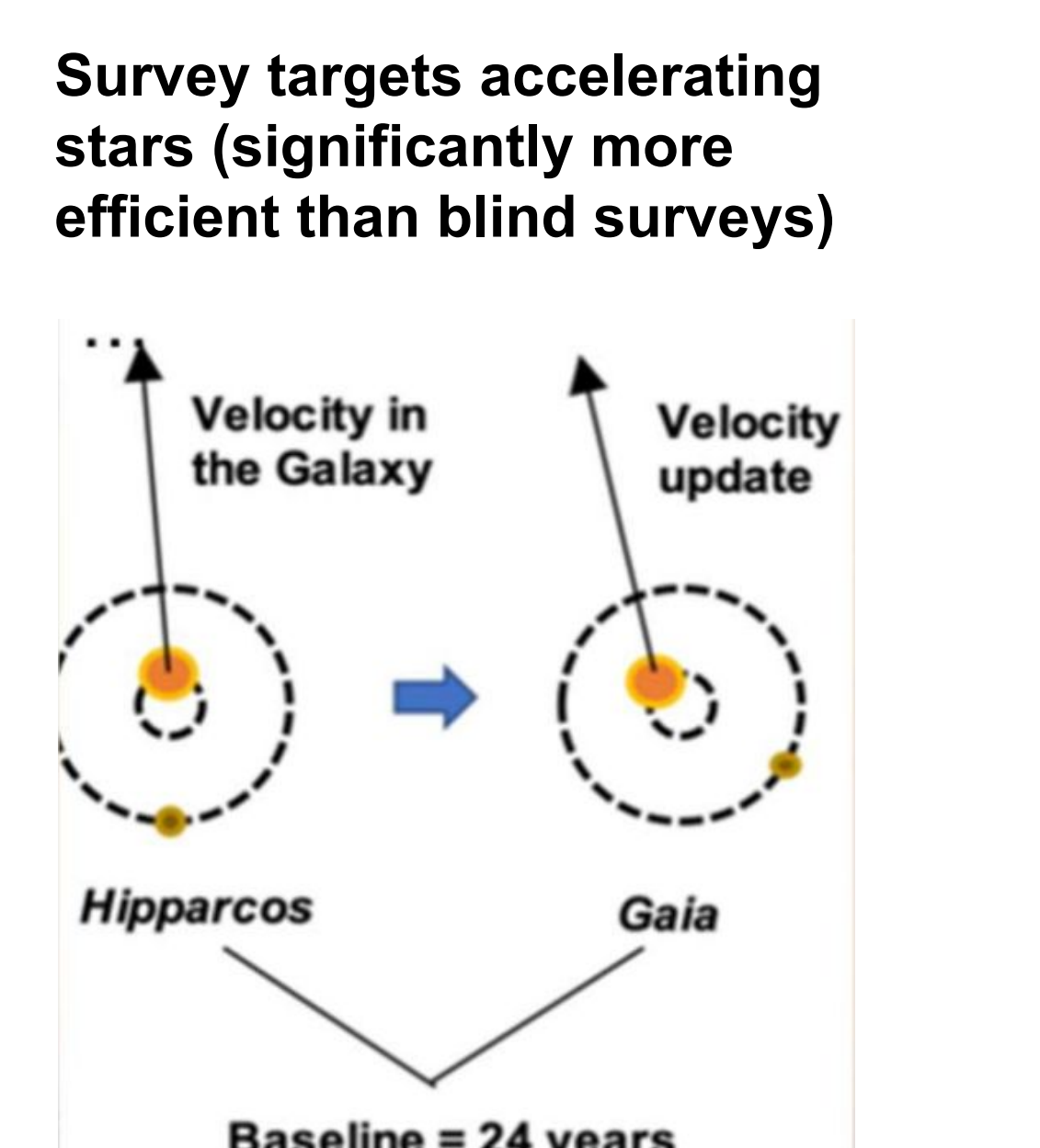
CHARIS SCIENCE MEASUREMENTS



CHARIS RECENT HIGHLIGHTS FROM THE OASIS INTENSIVE SURVEY

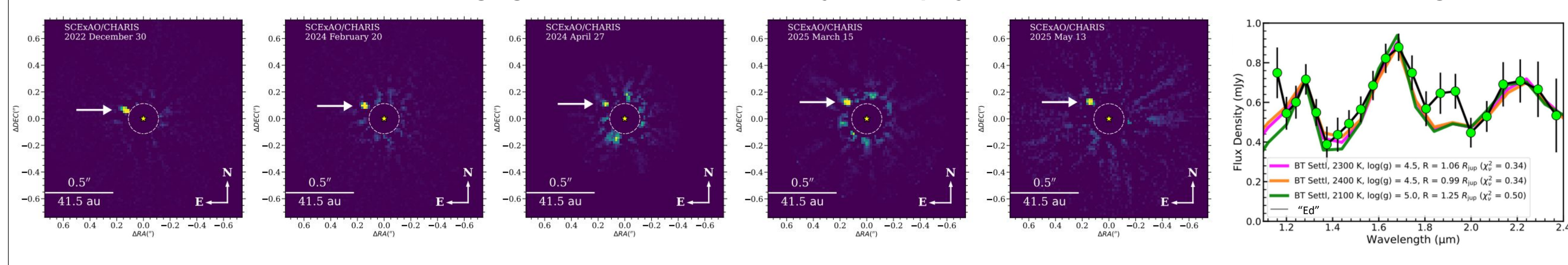
Example discoveries from the Observing Accelerators with SCEXAO Imaging Survey (OASIS)

Thayne Currie, Survey Principal Investigator (Subaru/U. Texas-Antonia)
Masayuki Kuzuhara, Survey Co-PI (NAOJ)



- Precision Astrometry from Gaia & Hipparcos Identifies Stars That Are Being Gravitationally Accelerated by An Unseen Companion
- Target accelerating stars that are young enough to have imageable planets

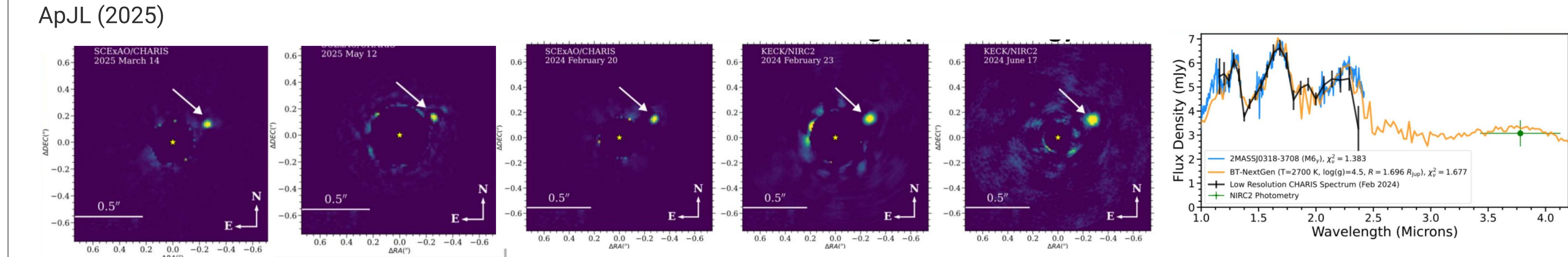
SCEXAO/CHARIS and Gaia Direct Imaging and Astrometric Discovery of a Superjovian Planet 3-4 λ/D from the Accelerating Star HIP 54515, Currie et al., ApJ (2026)



Orbits a very young A star that has never been the subject of a planet search before ~3-4 lambda/D separation!
~2100-2400 K, M/L transition object

Mass: ~17.6 Mj
Mass ratio ~9e-3 (similar to HR 8799 cde, HIP 99770 b)
sma ~ 25 au, ecc ~ 0.4

OASIS Survey Direct Imaging and Astrometric Discovery of HIP 71618 B: A Substellar Companion Suitable for the Roman Coronagraph Technology Demonstration, El Morsy et al. ApJL (2025)



A brown dwarf companion suitable for Roman Coronagraph Technology Demonstration

Development Activities

PSF reconstruction

Using WFS telemetry to reconstruct coronagraphic PSF. Currently in early development. On-sky tests have started in summer 2026 following promising in-lab results

Coronagraph Improvements

We are designing phase mask coronagraphs with smaller inner working angle and more efficient WFSing with the coronagraphic LOWFS.

Mitigating Low-Wind Effect

Some success obtained with Fast & Furious algorithm. LOWFS reconstruction with neural nets.

Data Analysis Server

We are deploying a data analysis server in Hilo to support observers with data reduction and new R&D initiatives related to PSF reconstruction.

Acknowledgements

The authors wish to recognize and acknowledge the very significant cultural role and reverence that the summit of Maunakea has always had within the Hawaiian community. We are most fortunate to have the opportunity to conduct observations from this mountain. The development of SCEXAO was supported by the National Astronomical Observatory of Japan (NAOJ), the Astrobiology Center of the National Institutes of Natural Sciences, Japan, the Subaru Telescope, the Japan Society for the Promotion of Science and the Mt Cuba Foundation.