

# Exploring the Jovian System with JWST

ERS Program 1373: Observations of the Jovian System as a demonstration of JWST's capabilities for Solar System science

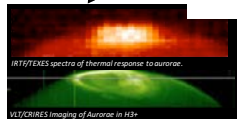
PIs: Imke de Pater (UC Berkeley), Thierry Fouchet (Obs. Paris)  
Poster prepared by: Al Conrad (LBTO / U of A)

## Jupiter:

- NIRCam
- NIRSpec IFU
- MIRI: MRS/IFU



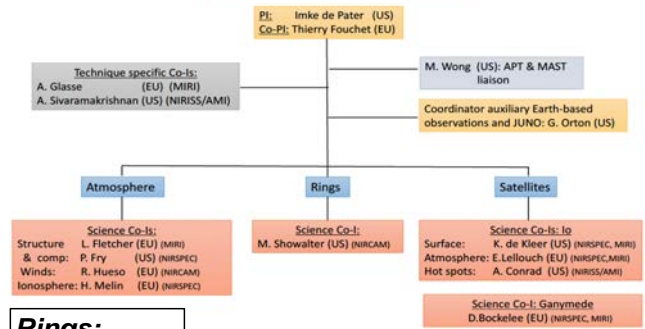
Main science question	Instrument/Mode	Main science deliverable	Main science-enabling product
Wind profile in SPR, at different latitudes	NIRCam Full array & SUB160 Various filters	Images, maps, wind fields at different wavelengths, i.e., albedos	Navigation & derotation software; Subarray planning tool
Structure Temp & gas composition in the upper troposphere and lower stratosphere of SPR	MIRI/MRS IFU Channels 1-4 (chs. 3-4 1.6-5.3 μm)	spectro-spatial maps at 5-11 μm to map boundary of polar vortex, and understand stratospheric heating & chemistry	Planning tool to mosaic regions on moving rotating object that fills field of view; Calibration procedures bright targets
Tropospheric aerosol structure + gas composition in SPR and GRS down to ~6-8 bar	NIRSpec IFU R=2700, 1.6-5.3 μm	IFU mosaics of SPR and GRS provide cloud/haze optical depths and gas abundances (e.g., NH <sub>3</sub> , PH <sub>3</sub> , H <sub>2</sub> O, CH <sub>4</sub> )	Blind target acquisition; Navigation, mosaicking, derotation software;
Aurora and upper stratosphere structure above SPR and GRS	NIRSpec IFU R=2700, 1.6-5.3 μm MIRI/MRS IFU R=2700, 6-18 μm	Maps of stratospheric species, e.g., H <sub>2</sub> <sup>+</sup> , CH <sub>4</sub> , C <sub>2</sub> H <sub>2</sub> , C <sub>2</sub> H <sub>4</sub>	Persistence performance; Inter-calibration of instruments



VLT/CRIRES Imaging of Auroras in H3+



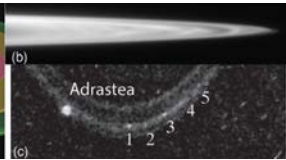
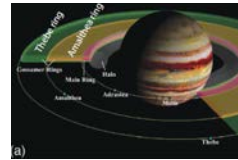
## Management Plan: The Jovian System



## Rings:

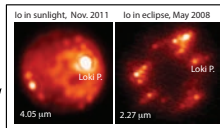
- NIRCam

Main science question	Instrument/Mode	Main science deliverable	Main science-enabling product
Structure; searches for moons and clumps; moon astronomy	NIRCam full Array, SUB400P in F212N, F150W2;	Images of the ring; moon astronomy	Persistence performance Scattered light pattern around Jupiter

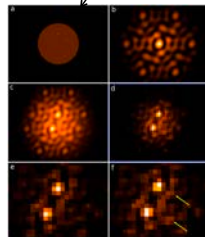


## Io:

- NIRSpec IFU
- MIRI MRS/IFU
- NIRISS/AMI

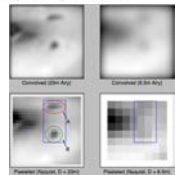


Main science question	Instrument/Mode	Main science deliverable	Main science-enabling product
Lava Temp of hot components	NIRSpec/IFU R=2700, 1.0-5.3 μm Eclipse	Map of volcanic hot spots on Io in eclipse; Temperature distribution in hot lavas	Assess potential to observe close to strong continuum source
Atmospheric control by volcanoes	NIRSpec/IFU R=2700, 1.0-1.9 μm Eclipse	Map of SO <sub>2</sub> 1.707 μm emission & Temp in eclipse, correlation with hot spots	Assess spectroscopy close to a large, bright continuum source
Bulk atmospheric Temp & SO <sub>2</sub> , and 3D distribution	MIRI/MRS IFU Channels 1-4 (chs. 3-4 saturated), all sub-bands	Map of SO <sub>2</sub> gas Temp and column density	Assess potential to detect weak absorption / emission features on a strong continuum
Structure of volcanic centers	NIRISS/AMI F430M	High-precision positioning of hot spots	Software tools for astrometry & photometry of point sources in crowded field



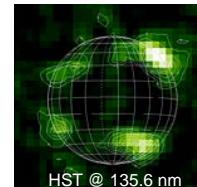
Simultaneous ground- and space-based observations in the JWST era  
Al Conrad\* and Christian Vollier\*  
\*Large Binocular Telescope Observatory, Tucson, Arizona. SPIE 2018

We scale the higher resolution data by the ratio of flux measured in a surrounding aperture (blue rectangle) to improve the photometric measurement for the two hot spots.



## Ganymede:

- NIRSpec IFU
- MIRI MRS/IFU



Main science question	Instrument/Mode	Main science deliverable	Main science-enabling product
Exospheric CO <sub>2</sub> surface composition	NIRSpec IFU R=2700, 2.7-5.27 μm	Spectra of exosphere and surface	Assess potential to map weak spectral lines on strong continuum, NIR
Exospheric H <sub>2</sub> O surface composition	MIRI/MRS IFU Channels 1-4 (chs. 3-4 saturated), all sub-bands	Spectra of exosphere; surface composition and thermal maps	Assess potential to map weak spectral lines on strong continuum, MIR
Auroral OI at 1.6 μm	NIRSpec IFU PRISM/CEAR; R=100, 0.6-5.3 μm Eclipse	Spectral maps of auroral OI of Ganymede in eclipse; search for other emissions	Assess potential for low resolution spectroscopy in eclipse near Jupiter

