



8696 - Ammonia and methane on a temperate giant planet orbiting a late M dwarf

Cycle: 4, Proposal Category: GO

INVESTIGATORS

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Dr. Matthew Conor Nixon (CoI)	Arizona State University
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Dr. Peter Gao (CoI)	Carnegie Institution of Washington
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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
One and only transit				
	1	Transit	NIRSpec Bright Object Time Series	(1) TOI-6894

ABSTRACT

TOI 6894 is the smallest star known to host a transiting giant planet. The Jupiter-sized TOI 6894b has an enormous 17% transit depth and a temperature of $T_{\text{eq}}=410$ K. We propose to measure its transmission spectrum with NIRSpec/PRISM (0.7--5.2 microns). With just a single transit, we can get a high S/N spectrum that shows prominent absorption features from NH₃, CH₄, and H₂O, which should be independently observable on each limb. Its temperature is low enough for nitrogen to be predominantly in NH₃, but not so low that NH₃ condenses. This fact, combined with the low gravity and large transit depth, makes TOI 6894b by far the best opportunity to probe the nitrogen chemistry of a giant exoplanet. The methane features will reveal whether methane depletion--frequently observed on hotter planets--applies in this colder regime. The precise metallicity, C/O, and N/O ratios we obtain will also constrain the planet's formation: is it a Y dwarf analog, or--as improbable as it may seem--a metallicity-enriched product of core accretion? Finally, the long ingress and egress makes TOI 6894b an ideal planet for measuring limb asymmetry--that is, obtaining the temperature and composition of each limb separately, which has never been achieved for a planet this cold.

OBSERVING DESCRIPTION

We take 5 h of continuous observations with NIRSpec/PRISM. There should be 2.0 +/- 0.5 h of baseline before the transit, followed by the 1.5 h transit, followed by 1.5 +/- 0.5 h of baseline. Using the NRSRAPID readout pattern and 10 groups/integration, the brightest pixel will be at 67% of saturation, according to the ETC.

Proposal 8696 - Targets - Ammonia and methane on a temperate giant planet orbiting a late M dwarf

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	TOI-6894	RA: 11 33 52.7495 (173.4697896d) Dec: +12 27 3.58 (12.45099d) Equinox: J2000	Proper Motion RA: -146.897 mas/yr Proper Motion Dec: 22.227 mas/yr Parallax: 0.0136842" Epoch of Position: 2000	
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>				
	<i>SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.</i>				
	<i>Category=Star</i>				
	<i>Description=[M dwarfs]</i>				
	<i>Extended=NO</i>				

Proposal 8696 - Observation 1 - Ammonia and methane on a temperate giant planet orbiting a late M dwarf

Thu Nov 27 00:00:41 GMT 2025

Observation	<p>Proposal 8696, Observation 1: Transit</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Bright Object Time Series</p>																															
Diagnostics	<p>(Transit (Obs 1)) Warning (Form): Exposure Duration exceeds the limit of 10000.0 seconds. Above this limit it is possible that a High Gain Antenna move may occur during the exposure.</p> <p>(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>																															
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Template	<p>Subarray</p> <p>SUB512</p>																															
Spectral Elements	<table border="1"> <thead> <tr> <th>#</th> <th>Grating/Filter</th> <th>Readout Pattern</th> <th>Groups/Int</th> <th>Integrations/Exp</th> <th>Exposures/Dith</th> <th>Total Dithers</th> <th>Total Integrations</th> <th>Total Exposure Time</th> <th>Optional ETC ID</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>PRISM/CLEAR</td> <td>NRSRAPID</td> <td>10</td> <td>7177</td> <td>1</td> <td>1</td> <td>7177</td> <td>18001.638</td> <td>225963</td> </tr> </tbody> </table>										#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID	1	PRISM/CLEAR	NRSRAPID	10	7177	1	1	7177	18001.638	225963		
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Special Requirements

Phase -0.0402 to -0.0278 with period 3.37077196 Days and zero-phase 2460313.411670 HJD
Time Series Observation
No Parallel Attachments