



6670 - Deciphering an Adolescent Warm Sub-Neptune to Unify Formation Models with Primordial Atmospheres

Cycle: 3, Proposal Category: GO

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Ms. Amy Joan Louca (PI) (ESA Member)	Universiteit Leiden
Dr. Billy Edwards (CoI) (ESA Member) (CoPI)	Space Research Organization Netherlands
Dr. Yamila Miguel (CoI) (ESA Member)	Universiteit Leiden
Dr. Nestor Espinoza (CoI) (US Admin CoI)	Space Telescope Science Institute

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1		NIRSpec Bright Object Time Series	(1) HD-22259A

ABSTRACT

HST ID: 5624

Prior observations of mature gas giants have shown evidence of metal-enhanced atmospheres with respect to their host-star. This enrichment could happen during the birth of the planet or it could be caused by atmospheric evolution. While formation and evolution models are able to provide various physical explanations, observational evidence to support any specific hypothesis is still missing due to an inability to distinguish the root-cause of metal-enhancement when studying evolved worlds. Atmospheric characterization of very young planets (<100 Myr), which are yet to experience significant atmospheric evolution, allows us to break the formation/evolution degeneracy and uncover the cause of metal-enrichment.

We propose to observe the young (45 Myr) planet DS Tuc Ab using simultaneous transmission spectroscopy with HST WFC3 and JWST NIRSpec to

measure the atmospheric metallicity and the carbon-to-oxygen ratio. Forward models show that water, methane, and carbon dioxide are the fundamental tracers of these characteristics, which are best distinguished by having a broad wavelength coverage. This can only be achieved by using both facilities. These data will also allow us to constrain the planet's mass which, in combination with the proposed STIS observations of the host star, will allow us to generate models of the planet's evolution to predict its final fate.

Therefore, these observations will give us strict constraints on formation and evolution pathways for this adolescent world. By also using observations of analogue mature planets, we will be able to construct a timeline of atmospheric evolution and find the source of metal-enrichment in exoplanets.

OBSERVING DESCRIPTION

We will observe a single transit of DS Tuc a b using JWST NIRSpec. The NIRSpec observations will be conducted in BOTS (Bright Object Time Series) mode, which requires the S1600A1 aperture with a fixed 1.6"x1.6" field of view (FoV). We will take exposures using the G39H/F290LP setup and will use the SUB2048 subarray (2048x32 pixels) to record the full spectrum across both detectors. We will take 3 groups per integration using the NISRAPID readout mode and a total of 5600 integrations. As DS Tuc A is too bright for target acquisition, we will calibrate the wavelength solution using the stellar spectrum.

We will also acquire a simultaneous transit observation with HST WFC3 G141, which will require 7 orbits of the spacecraft to cover the transit and provide enough baseline to detrend the data. An additional two, non time-critical, HST orbits will measure the UV spectrum of the star.

Proposal 6670 - Targets - Deciphering an Adolescent Warm Sub-Neptune to Unify Formation Models with Primordial Atmospheres

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	HD-222259A	RA: 23 39 39.4808 (354.9145033d) Dec: -69 11 44.71 (-69.19575d) Equinox: J2000	Proper Motion RA: 79.529 mas/yr Proper Motion Dec: -67.55100000646053 mas/yr Parallax: 0.022636700000000003" 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=[Exoplanets]</i>					

Proposal 6670 - Observation 1 - Deciphering an Adolescent Warm Sub-Neptune to Unify Formation Models with Primordial Atmospher...

Fri Oct 11 20:00:09 GMT 2024

Observation	<p>Proposal 6670, Observation 1</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Bright Object Time Series</p>																															
Diagnostics	<p>(Observation 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>																															
Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th colspan="4">Targ. Coord. Corrections</th> <th colspan="4">Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>HD-222259A</td> <td>RA: 23 39 39.4808 (354.9145033d) Dec: -69 11 44.71 (-69.19575d) Equinox: J2000</td> <td colspan="4">Proper Motion RA: 79.529 mas/yr Proper Motion Dec: -67.55100000646053 mas/yr Parallax: 0.022636700000000003" Epoch of Position: 2000</td> <td colspan="4"></td> </tr> </tbody> </table> <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><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></p> <p><i>Category=Star</i> <i>Description=[Exoplanets]</i></p>										#	Name	Target Coordinates	Targ. Coord. Corrections				Miscellaneous				(1)	HD-222259A	RA: 23 39 39.4808 (354.9145033d) Dec: -69 11 44.71 (-69.19575d) Equinox: J2000	Proper Motion RA: 79.529 mas/yr Proper Motion Dec: -67.55100000646053 mas/yr Parallax: 0.022636700000000003" Epoch of Position: 2000							
#	Name	Target Coordinates	Targ. Coord. Corrections				Miscellaneous																									
(1)	HD-222259A	RA: 23 39 39.4808 (354.9145033d) Dec: -69 11 44.71 (-69.19575d) Equinox: J2000	Proper Motion RA: 79.529 mas/yr Proper Motion Dec: -67.55100000646053 mas/yr Parallax: 0.022636700000000003" Epoch of Position: 2000																													
Template	TA Method					Subarray																										
	NONE					SUB2048																										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID																						
	1	G395H/F290LP	NRSRAPID	3	5600	1	1	5600	20319.488																							
Special Requirements	<p>Phase 0.9819 to 0.98702 with period 8.1382123415 Days and zero-phase 2458332.3098858669 HJD</p> <p>Time Series Observation</p> <p>No Parallel Attachments</p>																															