3615 - Exploring the boundary between rocky and gaseous planets with WASP-47 e

Cycle: 2, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Mr. Sebastian Zieba (PI) (ESA Member)	**Max Planck Institute for Astronomy**
Dr. Laura Kreidberg (CoI) (ESA Member)	Max Planck Institute for Astronomy
Dr. Yamila Miguel (CoI) (ESA Member)	Universiteit Leiden
Mantas Zilinskas (CoI) (ESA Member)	Universiteit Leiden
Christiaan van Buchem (CoI) (ESA Member)	Universiteit Leiden
Dr. Andrew Vanderburg (CoI) (US Admin CoI)	Massachusetts Institute of Technology

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
WASP-47e NIRSpec BOTS				
	1	WASP-47e - G395H	NIRSpec Bright Object Time Series	(1) WASP-47
	2	WASP-47e - G395H	NIRSpec Bright Object Time Series	(1) WASP-47

ABSTRACT

Ultra-short-period (USP) planets have orbital periods shorter than a day and are therefore being blasted by radiation from their host stars. The majority of these small USP planets have bulk densities consistent with Earth-like compositions, with two notable exceptions clearly showing lower densities: 55 Cnc e and WASP-47 e. Both planets lie directly in the radius valley between super-Earths and sub-Neptunes, providing an exciting opportunity to test the boundary between rocky and gaseous planets. In addition, both planets orbit in multi-planet systems with similar architectures, possibly implying a similar formation history. Compared to 55 Cnc e, WASP-47 e is advantageous because the other planets in the system are transiting, offering an opportunity for comparative planetology. The host star is also fainter, so observing WASP-47 e doesn't push the performance of the detectors on JWST to the extreme limit that 55 Cnc does. Two secondary eclipse observations of WASP-47 e will distinguish at 4.5 sigma significance whether the planet is a bare rock and possibly part of a proposed exotic class of exoplanets without cores, or whether it holds onto a CO-

and CO2-rich atmosphere, which is expected from a remnant atmosphere affected by photoevaporation.

OBSERVING DESCRIPTION

We propose to observe 2 secondary eclipses of the Ultra-Short-Period planet WASP-47 e with NIRSpec in the G395H/F290LP mode. We account for an additional 30 minutes of burn-in at the beginning of the observations to let the detectors settle. The observations have to coincide with the eclipse of the planet but avoid transits and eclipses of the other two transiting planets in the system.

The target is too bright for direct acquisition, so we will acquire on a fainter star first and then offset to our science target.

We checked for saturation using the ETC and chose a number of Groups per Integration which keeps all pixel below 50% saturation. We request two eclipse observations with a duration of 6.2 hours (= 551 integrations) per visit. We determined the number of groups per integration to be 44. This leads to a time of 40.6 seconds for one integration.

With a period of 0.79 days for WASP-47 e and accounting for the visibility of the star, there are 123 eclipses to observe in Cycle 2 (July 1st, 2023 - June 30th, 2024).

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-47	RA: 22 04 48.7426 (331.2030942d) Dec: -12 01 8.66 (-12.01907d) Equinox: J2000	Proper Motion RA: 15.074320617038932 mas/yr Proper Motion Dec: -41.466537001088156 mas/yr Parallax: 0.0037009772650191635" Epoch of Position: 2016	
(2)	WASP-47-TA	RA: 22 04 47.1632 (331.1965133d) Dec: -12 01 32.10 (-12.02558d) Equinox: J2000	Proper Motion RA: -3.0383318148530547 mas/yr Proper Motion Dec: -5.020025620759003 mas/yr Parallax: 0.0002549760770989133" Epoch of Position: 2016	

Comments for (1):

Comments: Data taken from the Gaia archive.

DR3 2613413008919918976
2MASS J22044873-1201079

From Simbad:
Parallaxes (mas): 3.701 [0.0201] A 2020yCat.1350....0G
Fluxes (9) :
V 11.99 [0.01] D 2012yCat.1322....0Z
R 11.82 [0.04] D 2012yCat.1322....0Z
G 11.781729 [0.002769] C 2020yCat.1350....0G
J 10.613 [0.022] C 2003yCat.2246....0C
H 10.310 [0.022] C 2003yCat.2246....0C
K 10.192 [0.026] C 2003yCat.2246....0C
g 12.22 [0.04] D 2012yCat.1322....0Z
r 11.77 [0.07] D 2012yCat.1322....0Z
i 11.57 [0.04] D 2012yCat.1322....0Z
Category=Star
Description=[Exoplanet Systems, G stars]

Comments for (2):

Comments: Data taken from the Gaia archive.

This object is the closest point sorce to WASP-47 in the 2MASS All-Sky Point Source Catalog (PSC).
Gaia DR3 2613413008919919104
2MASS J22044716-1201319
Category=Unidentified
Description=[Infrared sources, Visible sources]

Observation

Proposal 3615, Observation 1: WASP-47e - G395H Thu May 11 01:19:29 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: We require that the eclipse observation of WASP-47 e does not occur at the same time as transits or eclipses of WASP-47 b or WASP-47 d. Accounting for this, there are approximately 90 possibilities left in Cycle 2 for JWST to perform an eclipse observation of WASP-47 e. We will work with the Contact Scientist to schedule eclipses that do not coincide with the other planets in the system.
Ephemeris taken from Bryant & Bayliss 2022

Diagnostics

(WASP-47e - G395H (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.

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-47	RA: 22 04 48.7426 (331.2030942d) Dec: -12 01 8.66 (-12.01907d) Equinox: J2000	Proper Motion RA: 15.074320617038932 mas/yr Proper Motion Dec: -41.466537001088156 mas/yr Parallax: 0.0037009772650191635" Epoch of Position: 2016	

Comments: Data taken from the Gaia archive.

DR3 2613413008919918976
2MASS J22044873-1201079

From Simbad:
Parallaxes (mas): 3.701 [0.0201] A 2020yCat.1350....0G
Fluxes (9) :
V 11.99 [0.01] D 2012yCat.1322....0Z
R 11.82 [0.04] D 2012yCat.1322....0Z
G 11.781729 [0.002769] C 2020yCat.1350....0G
J 10.613 [0.022] C 2003yCat.2246....0C
H 10.310 [0.022] C 2003yCat.2246....0C
K 10.192 [0.026] C 2003yCat.2246....0C
g 12.22 [0.04] D 2012yCat.1322....0Z
r 11.77 [0.07] D 2012yCat.1322....0Z
i 11.57 [0.04] D 2012yCat.1322....0Z
Category=Star
Description=[Exoplanet Systems, G stars]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 WASP-47-TA	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	145642

Template

Subarray
SUB2048

Proposal 3615 - Observation 1 - Exploring the boundary between rocky and gaseous planets with WASP-47 e

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	44	551	1	1	551	22376.374	145642

Special Requirements

Phase 0.29702429277 to 0.34979407522 with period 0.7895933 Days and zero-phase 2457011.34862 HJD
Time Series Observation
No Parallel Attachments

Observation

Proposal 3615, Observation 2: WASP-47e - G395H Thu May 11 01:19:29 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

Comments: We require that the eclipse observation of WASP-47 e does not occur at the same time as transits or eclipses of WASP-47 b or WASP-47 d. Accounting for this, there are approximately 90 possibilities left in Cycle 2 for JWST to perform an eclipse observation of WASP-47 e. We will work with the Contact Scientist to schedule eclipses that do not coincide with the other planets in the system.
Ephemeris taken from Bryant & Bayliss 2022

Diagnostics

(WASP-47e - G395H (Obs 2)) 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.

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WASP-47	RA: 22 04 48.7426 (331.2030942d)	Proper Motion RA: 15.074320617038932 mas/yr	
		Dec: -12 01 8.66 (-12.01907d)	Proper Motion Dec: -41.466537001088156 mas/yr	
		Equinox: J2000	Parallax: 0.0037009772650191635"	
			Epoch of Position: 2016	

Comments: Data taken from the Gaia archive.

DR3 2613413008919918976
2MASS J22044873-1201079

From Simbad:
Parallaxes (mas): 3.701 [0.0201] A 2020yCat.1350....0G
Fluxes (9) :
V 11.99 [0.01] D 2012yCat.1322....0Z
R 11.82 [0.04] D 2012yCat.1322....0Z
G 11.781729 [0.002769] C 2020yCat.1350....0G
J 10.613 [0.022] C 2003yCat.2246....0C
H 10.310 [0.022] C 2003yCat.2246....0C
K 10.192 [0.026] C 2003yCat.2246....0C
g 12.22 [0.04] D 2012yCat.1322....0Z
r 11.77 [0.07] D 2012yCat.1322....0Z
i 11.57 [0.04] D 2012yCat.1322....0Z
Category=Star
Description=[Exoplanet Systems, G stars]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 WASP-47-TA	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	145642

Template

Subarray
SUB2048

Proposal 3615 - Observation 2 - Exploring the boundary between rocky and gaseous planets with WASP-47 e

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	44	551	1	1	551	22376.374	145642

Special Requirements

Phase 0.29702429277 to 0.34979407522 with period 0.7895933 Days and zero-phase 2457011.34862 HJD
Time Series Observation
No Parallel Attachments