



11464 - A spectroscopic test of the origins of Earth co-orbitals with JWST/NIRSpec

Cycle: 5, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1	NIRSpecIFU-164207	NIRSpec IFU Spectroscopy	(1) 164207
	2	NIRSpecIFU-277810	NIRSpec IFU Spectroscopy	(2) 277810
	3	NIRSpecIFU-2025PN7	NIRSpec IFU Spectroscopy	(3) 2025PN7
	4	NIRSpecIFU-2013LX28	NIRSpec IFU Spectroscopy	(4) 2013LX28
	5	NIRSpecIFU-85770	NIRSpec IFU Spectroscopy	(5) 85770
	6	NIRSpecIFU-706765	NIRSpec IFU Spectroscopy	(6) 706765

ABSTRACT

JWST Proposal 11464 (Created: Tuesday, September 15, 2026, 12:00:28PM Eastern Standard Time) - Overview

Earth co-orbitals are a class of asteroids that become temporarily captured in a $\sim 1:1$ orbital resonance with the Earth. Out of ~ 1 million known asteroids, only a handful of Earth co-orbitals exist on quasi-stable orbits. Numerical integration of the orbits of quasi-stable co-orbitals shows that they have been oscillating within the Earth's orbit for hundreds to thousands of years. There are two competing hypotheses for the origin of Earth's co-orbitals: capture from the near-Earth asteroid population and capture of debris originating from impacts on the Moon. Accurately tracing the orbits of Earth's co-orbitals over more than a hundred years is impossible due to dynamical chaos. Therefore, we propose an observational approach to test the origin of the Earth's co-orbitals. We will use a combination of visible and near-infrared spectrophotometry to determine the spectra of six Earth co-orbitals from the quasi-satellite, Trojan, and horseshoe subgroups. We will obtain low-resolution NIRSpec spectra between 0.6 and 5.3 microns to test their composition. Detecting differences in the spectra of lunar and asteroidal silicate material is enabled by NIRSpec's full spectral range and sensitivity, which would be impossible from the ground. Our results are likely to have a high impact in both cases, whether our targets have asteroidal or lunar origins, since they will drastically expand our knowledge of the population of Earth co-orbitals whose spectra are largely unknown, and will have broad-reaching implications for the impact history of the Moon.

OBSERVING DESCRIPTION

Our science program will consist of three visits for six different Earth co-orbitals. Each visit for each target will consist of a NIRSpec observation of a science target. Our observations will not require the Background Limited special requirement, as the difference between the SNR assuming a high background and that assuming a low background at the sky locations of our targets on our expected date of observation is very small. We request moving object support for our targets that is moving, < 3 arcsec/min, well below the tracking limit of JWST. We have limited the duration of our observations to a single visit for each of our targets, so that they do not move beyond the 38 arcsec splitting distance.

For our NIRSpec observations, we will use Prism/CLEAR mode and cover an area of 3 arcsec x 3 arcsec centered on the comet at a resolution of 0.1 arcseconds. We will observe in NRS readout mode, taking 12-15 groups/integrations, one integration per exposure with a 4-point dither, for a total of 4 integrations and a total exposure time of ~ 2100 -2700 seconds. This will provide a spectrum in each spaxel with an SNR of at least 30 per spectral bin in our relevant wavelength region. We will not use a target-acquisition method because the ephemeris uncertainty of our targets is < 1 arcsecond so that the targets will fit comfortably within the NIRSpec IFU's 3 arcsec field of view. We will observe our target with non-sidereal tracking. We do not require the use of the meteorite avoidance zone for our observations.

The observations of three of our targets, 2013 LX28, 85770, and 706765, are affected by the Meteoroid Avoidance Zone since it is only observable here. We request observations for 2013 LX28, 85770, and 706765 because they would otherwise be unscheduled. All of our other targets can be observed out of the Meteoroid Avoidance Zone.

Proposal 11464 - Targets - A spectroscopic test of the origins of Earth co-orbitals with JWST/NIRSpec

Solar System Targets	#	Name	Level 1	Level 2	Level 3
	(1)	164207	TYPE=ASTEROID,A=1.00136326359031,E=0.13602 68417023479,I=13.65068755369906 ,O=38.55811333210502,W=279.9484568229833,M=2 77.3230926056547,EQUINOX=J2000,EPOCH=19- MAY-2019:00:00:00,EpochTimeScale=TDB,R0=1. ,A1=0.,A2=-5.699760095013E-14,A3=0. ,ALN=1.,NM=2.,NN=5.093,NK=0.,AMRAT=0.		
	Comments: Extended=Unknown				
	(2)	277810	TYPE=ASTEROID,A=1.001345679475226,E=0.3774 211813542541,I=7.103485412734107 ,O=179.495790667037,W=170.8268905034831,M=42. 32143863517864,EQUINOX=J2000,EPOCH=13- OCT-2019:00:00:00,EpochTimeScale=TDB,R0=1. ,A1=0.,A2=4.160157004662E-14,A3=0. ,ALN=1.,NM=2.,NN=5.093,NK=0.,AMRAT=0.		
	Comments: Extended=Unknown				
	(3)	2025PN7	TYPE=ASTEROID,A=1.001371524920585,E=0.1081 889414662568,I=1.976855692672289,O=112.1947067 454172,W=79.90863359164803,M=54.045849221908 45,EQUINOX=J2000,EPOCH=09-JUN- 2026:00:00:00,EpochTimeScale=TDB,R0=1.,A2=- 1.485149078059794E-13,ALN=1.,NM=2.,NK=0.		
	Comments: Extended=Unknown				
	(4)	2013LX28	TYPE=ASTEROID,A=1.001613366492417,E=0.4520 403737572545,I=49.98140012832179 ,O=76.67269371875315,W=345.7768499808169,M=1 42.6691806033172,EQUINOX=J2000,EPOCH=08- APR-2019:00:00:00,EpochTimeScale=TDB		
	Comments: Extended=Unknown				
	(5)	85770	TYPE=ASTEROID,A=0.9976760608731493,E=0.345 1936138336726,I=33.17703972157087,O=18.3145485 7354581,W=234.2372625825293,M=350.5188791978 004,EQUINOX=J2000,EPOCH=09-JUN- 2026:00:00:00,EpochTimeScale=TDB,R0=1.,A2=- 4.556229204935677E-14,ALN=1.,NM=2.,NK=0.		
Comments: Extended=Unknown					
(6)	706765	TYPE=ASTEROID,A=0.9985079154055611,E=0.190 2680595539314,I=20.90571103737795,O=96.4145425 9883588,W=46.06984972911918,M=144.4203265437 717,EQUINOX=J2000,EPOCH=09-JUN- 2026:00:00:00,EpochTimeScale=TDB			
Comments: Extended=Unknown					

Proposal 11464 - Observation 1 - A spectroscopic test of the origins of Earth co-orbitals with JWST/NIRSpec

Observation	Proposal 11464, Observation 1: NIRSpecIFU-164207											Tue Sep 15 17:00:28 GMT 2026
	Diagnostic Status: Warning											
	Observing Template: NIRSpec IFU Spectroscopy											
Diagnostics	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
	(NIRSpecIFU-164207 (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(1)	164207	TYPE=ASTEROID,A=1.00136326359031,E=0.1360268417023479,I=13.65068755369906,O=38.55811333210502,W=279.9484568229833,M=277.3230926056547,EQUINOX=J2000,EPOCH=19-MAY-2019:00:00:00,EpochTimeScale=TDB,R0=1.,A1=0.,A2=-5.699760095013E-14,A3=0.,ALN=1.,NM=2.,NN=5.093,NK=0.,AMRAT=0.									
	Comments: Extended=Unknown											
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	PRISM/CLEAR	NRSIRS2RAPID	27	1	false	true	NONE	4	4	1633.956	173889
Special Requirements	Between Dates 05-JAN-2027:00:00:00 and 25-JAN-2027:00:00:00											
	DEFAULT WINDOW: ANGULAR RATE 164207 FROM JWST LESS THAN 0.075											

Proposal 11464 - Observation 2 - A spectroscopic test of the origins of Earth co-orbitals with JWST/NIRSpec

Observation	Proposal 11464, Observation 2: NIRSpecIFU-277810											Tue Sep 15 17:00:28 GMT 2026
	Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
Diagnostics	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (NIRSpecIFU-277810 (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Solar System Targets	#	Name	Level 1				Level 2			Level 3		
	(2)	277810	TYPE=ASTEROID,A=1.001345679475226,E=0.3774 211813542541,I=7.103485412734107 ,O=179.495790667037,W=170.8268905034831,M=42. 32143863517864,EQUINOX=J2000,EPOCH=13- OCT-2019:00:00:00,EpochTimeScale=TDB,R0=1. ,A1=0.,A2=4.160157004662E-14,A3=0. ,ALN=1.,NM=2.,NN=5.093,NK=0.,AMRAT=0. Comments: Extended=Unknown									
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	PRISM/CLEAR	NRSIRS2RAPID	45	1	false	true	NONE	4	4	2684.356	173889
Special Requirements	Between Dates 08-FEB-2027:00:00:00 and 18-FEB-2027:00:00:00 Between Dates 09-APR-2027:00:00:00 and 25-APR-2027:00:00:00 DEFAULT WINDOW: ANGULAR RATE 277810 FROM JWST LESS THAN 0.075											

Proposal 11464 - Observation 3 - A spectroscopic test of the origins of Earth co-orbitals with JWST/NIRSpec

Observation	Proposal 11464, Observation 3: NIRSpecIFU-2025PN7											Tue Sep 15 17:00:28 GMT 2026
	Diagnostic Status: Warning											
	Observing Template: NIRSpec IFU Spectroscopy											
Diagnostics	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
	(NIRSpecIFU-2025PN7 (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(3)	2025PN7	TYPE=ASTEROID,A=1.001371524920585,E=0.1081 889414662568,I=1.976855692672289,O=112.1947067 454172,W=79.90863359164803,M=54.045849221908 45,EQUINOX=J2000,EPOCH=09-JUN- 2026:00:00:00,EpochTimeScale=TDB,R0=1.,A2=- 1.485149078059794E-13,ALN=1.,NM=2.,NK=0.									
	Comments: Extended=Unknown											
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	PRISM/CLEAR	NRSIRS2RAPID	70	1	false	true	NONE	4	4	4143.245	173889
Special Requirements	Between Dates 15-SEP-2026:00:00:00 and 19-SEP-2026:00:00:00											
	DEFAULT WINDOW: ANGULAR RATE 2025PN7 FROM JWST LESS THAN 0.075											

Proposal 11464 - Observation 4 - A spectroscopic test of the origins of Earth co-orbitals with JWST/NIRSpec

Observation	Proposal 11464, Observation 4: NIRSpecIFU-2013LX28											Tue Sep 15 17:00:28 GMT 2026
	Diagnostic Status: Warning											
	Observing Template: NIRSpec IFU Spectroscopy											
Diagnostics	(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
	(NIRSpecIFU-2013LX28 (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
	(Visit 4:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(4)	2013LX28	TYPE=ASTEROID,A=1.001613366492417,E=0.4520 403737572545,I=49.98140012832179 ,O=76.67269371875315,W=345.7768499808169,M=1 42.6691806033172,EQUINOX=J2000,EPOCH=08- APR-2019:00:00:00,EpochTimeScale=TDB									
	Comments: Extended=Unknown											
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	PRISM/CLEAR	NRSIRS2RAPID	32	1	false	true	NONE	4	4	1925.733	173889
Special Requirements	Between Dates 14-MAY-2027:00:00:00 and 19-MAY-2027:00:00:00											
	DEFAULT WINDOW: ANGULAR RATE 2013LX28 FROM JWST LESS THAN 0.075											

Proposal 11464 - Observation 5 - A spectroscopic test of the origins of Earth co-orbitals with JWST/NIRSpec

Observation	Proposal 11464, Observation 5: NIRSpecIFU-85770											Tue Sep 15 17:00:28 GMT 2026
	Diagnostic Status: Warning											
	Observing Template: NIRSpec IFU Spectroscopy											
Diagnostics	(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
	(NIRSpecIFU-85770 (Obs 5)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
	(Visit 5:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(5)	85770	TYPE=ASTEROID,A=0.9976760608731493,E=0.345 1936138336726,I=33.17703972157087,O=18.3145485 7354581,W=234.2372625825293,M=350.5188791978 004,EQUINOX=J2000,EPOCH=09-JUN- 2026:00:00:00,EpochTimeScale=TDB,R0=1.,A2=- 4.556229204935677E-14,ALN=1.,NM=2.,NK=0.									
	Comments: Extended=Unknown											
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	PRISM/CLEAR	NRSIRS2RAPID	18	1	false	true	NONE	4	4	1108.756	173889
Special Requirements	Between Dates 09-SEP-2026:00:00:00 and 28-SEP-2026:00:00:00											
	DEFAULT WINDOW: ANGULAR RATE 85770 FROM JWST LESS THAN 0.075											

Proposal 11464 - Observation 6 - A spectroscopic test of the origins of Earth co-orbitals with JWST/NIRSpec

Observation	Proposal 11464, Observation 6: NIRSpecIFU-706765											Tue Sep 15 17:00:28 GMT 2026
	Diagnostic Status: Warning											
	Observing Template: NIRSpec IFU Spectroscopy											
Diagnostics	(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
	(NIRSpecIFU-706765 (Obs 6)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
	(Visit 6:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(6)	706765	TYPE=ASTEROID,A=0.9985079154055611,E=0.190 2680595539314,I=20.90571103737795,O=96.4145425 9883588,W=46.06984972911918,M=144.4203265437 717,EQUINOX=J2000,EPOCH=09-JUN-2026:00:00:00,EpochTimeScale=TDB									
	Comments: Extended=Unknown											
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type			Size	Starting Point			Number of Points		Points	
	1	4-POINT-DITHER										
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	PRISM/CLEAR	NRSIRS2RAPID	39	1	false	true	NONE	4	4	2334.222	173889
Special Requirements	Between Dates 20-SEP-2026:00:00:00 and 05-OCT-2026:00:00:00											
	DEFAULT WINDOW: ANGULAR RATE 706765 FROM JWST LESS THAN 0.075											