



8782 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Cycle: 4, 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>
NIRSPEC Observations of Asteroids				
	6	Asporina	NIRSpec IFU Spectroscopy	(8) Asporina
	7	Justitia	NIRSpec IFU Spectroscopy	(9) Justitia
	8	Eos	NIRSpec IFU Spectroscopy	(7) Eos
	9	Pandora	NIRSpec IFU Spectroscopy	(3) Pandora
	10	Lutetia	NIRSpec IFU Spectroscopy	(2) Lutetia
	11	Sylvia	NIRSpec IFU Spectroscopy	(5) Sylvia
	12	Angelina	NIRSpec IFU Spectroscopy	(4) Angelina
	13	Aegle	NIRSpec IFU Spectroscopy	(6) Aegle
	14	Dembowska	NIRSpec IFU Spectroscopy	(10) Dembowska
	15	Astraea	NIRSpec IFU Spectroscopy	(1) Astraea

ABSTRACT

The origin of Earth's water remains a central question in planetary science, with current models often emphasizing delivery from carbonaceous (C) chondrite-like bodies from the outer solar system. However, isotopic studies suggest that non-C materials may have played a significant role in

delivering water to Earth, highlighting the need to better understand water distribution in these bodies. This study aims to assess the abundance and distribution of water in non-C complex asteroids using near-infrared spectra obtained by the James Webb Space Telescope (JWST). We propose to observe the 2.5–3.5 μm region with the NIRSpec/IFU; in this spectral range, diagnostic OH and H₂O absorption features reveal key details about the mineralogy and speciation of hydrated phases. Critically, ground-based observations cannot access this region due to telluric absorptions, making JWST uniquely capable of capturing these diagnostic features. By studying these features, we aim to determine whether nominally anhydrous asteroids exhibit evidence of hydration and if OH/H₂O abundance correlates with heliocentric distance. These observations will provide new insights into the diversity of water sources in the solar system, ultimately advancing our understanding of whether the early inner solar system contained sufficient water to contribute significantly to Earth's water supply.

OBSERVING DESCRIPTION

We will obtain 1.7-5.3 micron observations of ten nominally-anhydrous asteroids in the main asteroid belt in order to determine (a) whether they are hydrated, and (b) the origins of their hydration. These determinations are made based on the hydration feature at 2.5-3.5 microns, and our exposure time settings are chosen to ensure SNR>200 and non-saturation over this wavelength range specifically. We will use the NIRSpec/IFU with the 235M and 395M gratings, except in a few cases where our targets saturate in these gratings, in which cases we will use the 235H and/or 395H gratings instead.

Proposal 8782 - Targets - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

#	Name	Level 1	Level 2	Level 3
(1)	Astraea	TYPE=ASTEROID,A=2.573431161100588,E=0.1915 131708652443,I=5.367907898214483 .O=141.5841078022262,W=358.7833712899293,M=9 4.3757632772293,EQUINOX=J2000,EPOCH=01- MAR-2017:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=Unknown</i>				
(2)	Lutetia	TYPE=ASTEROID,A=2.434591596950181,E=0.1644 174523168627,I=3.063715686325231 .O=80.87713172495945,W=249.980528756004,M=19 8.5328256338144,EQUINOX=J2000,EPOCH=12- OCT-2017:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=Unknown</i>				
(3)	Pandora	TYPE=ASTEROID,A=2.760353146294205,E=0.1426 768307888727,I=7.180674417908932 .O=10.39246276409876,W=5.217238916821356,M=2 51.5241585259491,EQUINOX=J2000,EPOCH=03- DEC-2017:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=Unknown</i>				
(4)	Angelina	TYPE=ASTEROID,A=2.682061017337263,E=0.1259 229852646316,I=1.309429328449573 .O=309.1385747575252,W=178.7597481437618,M=2 59.8122059692456,EQUINOX=J2000,EPOCH=16- AUG-2017:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=Unknown</i>				
(5)	Sylvia	TYPE=ASTEROID,A=3.481867548313324,E=0.0927 3832403996568,I=10.87674252603503 .O=73.04710377946407,W=263.5299399254934,M=2 9.47461264157099,EQUINOX=J2000,EPOCH=05- MAR-2018:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=YES</i>				
(6)	Aegle	TYPE=ASTEROID,A=3.050550926525714,E=0.1394 41362739715,I=15.96871181465607 .O=321.6215233911414,W=208.9365614564554,M=3 43.3574580856379,EQUINOX=J2000,EPOCH=14- JUL-2017:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=Unknown</i>				
(7)	Eos	TYPE=ASTEROID,A=3.009302672515265,E=0.1045 592646201668,I=10.8811371877922 .O=141.8385458658854,W=193.3429859911106,M=1 59.4317940552864,EQUINOX=J2000,EPOCH=04- DEC-2017:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=Unknown</i>				
(8)	Asporina	TYPE=ASTEROID,A=2.693766192170608,E=0.1097 565577163695,I=15.62589985268276 .O=162.3480168158944,W=96.63599043604482,M=1 50.9961854077993,EQUINOX=J2000,EPOCH=26- APR-2016:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=NO</i>				
(9)	Justitia	TYPE=ASTEROID,A=2.616503537445986,E=0.2131 486726553788,I=5.477114467883687 .O=156.7301162964065,W=119.5405784544796,M=1 18.4334470829392,EQUINOX=J2000,EPOCH=16- AUG-2019:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=Unknown</i>				

Solar System Targets

Proposal 8782 - Targets - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

(10)	Dembowska	TYPE=ASTEROID,A=2.924081222631155,E=0.0915 048417451164,I=8.246259994868856 ,O=32.34987096376179,W=346.1485932458316,M=3 48.7584827404064,EQUINOX=J2000,EPOCH=28- FEB-2017:00:00:00,EpochTimeScale=TDB
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Comments: Extended=Unknown

Proposal 8782 - Observation 6 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	<p>Proposal 8782, Observation 6: Asporina</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Asporina (Obs 6)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(8)	Asporina	TYPE=ASTEROID,A=2.693766192170608,E=0.1097565577163695,I=15.62589985268276,O=162.3480168158944,W=96.63599043604482,M=150.9961854077993,EQUINOX=J2000,EPOCH=26-APR-2016:00:00:00,EpochTimeScale=TDB									
	<i>Comments: Extended=NO</i>											
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	G235M/F170LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.2
	2	G395M/F290LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.3
Special Requirements	DEFAULT WINDOW: ANGULAR RATE Asporina FROM JWST LESS THAN 0.075											

Proposal 8782 - Observation 7 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	Proposal 8782, Observation 7: Justitia Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Justitia (Obs 7)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(9)	Justitia	TYPE=ASTEROID,A=2.616503537445986,E=0.2131 486726553788,I=5.477114467883687 ,O=156.7301162964065,W=119.5405784544796,M=1 18.4334470829392,EQUINOX=J2000,EPOCH=16- AUG-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	G235M/F170LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.4
	2	G395M/F290LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.5
Special Requirements	DEFAULT WINDOW: ANGULAR RATE Justitia FROM JWST LESS THAN 0.075											

Proposal 8782 - Observation 8 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	<p>Proposal 8782, Observation 8: Eos</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Eos (Obs 8)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(7)	Eos	TYPE=ASTEROID,A=3.009302672515265,E=0.1045 592646201668,I=10.8811371877922 .O=141.8385458658854,W=193.3429859911106,M=1 59.4317940552864,EQUINOX=J2000,EPOCH=04- DEC-2017:00:00:00,EpochTimeScale=TDB									
	<i>Comments: Extended=Unknown</i>											
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	G235M/F170LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.6
	2	G395M/F290LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.7
Special Requirements	DEFAULT WINDOW: ANGULAR RATE Eos FROM JWST LESS THAN 0.075											

Proposal 8782 - Observation 9 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	<p>Proposal 8782, Observation 9: Pandora</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 9:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Pandora (Obs 9)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(3)	Pandora	TYPE=ASTEROID,A=2.760353146294205,E=0.1426768307888727,I=7.180674417908932,O=10.39246276409876,W=5.217238916821356,M=251.5241585259491,EQUINOX=J2000,EPOCH=03-DEC-2017:00:00:00,EpochTimeScale=TDB									
	<i>Comments: Extended=Unknown</i>											
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	G235M/F170LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.8
	2	G395M/F290LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.9
Special Requirements	DEFAULT WINDOW: ANGULAR RATE PANDORA FROM JWST LESS THAN 0.075											

Proposal 8782 - Observation 10 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	Proposal 8782, Observation 10: Lutetia Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Lutetia (Obs 10)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(2)	Lutetia	TYPE=ASTEROID,A=2.434591596950181,E=0.1644 174523168627,I=3.063715686325231 ,O=80.87713172495945,W=249.980528756004,M=19 8.5328256338144,EQUINOX=J2000,EPOCH=12- OCT-2017:00:00:00,EpochTimeScale=TDB <i>Comments: Extended=Unknown</i>									
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	G235H/F170LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.10
	2	G395M/F290LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.11
Special Requirements	DEFAULT WINDOW: ANGULAR RATE Lutetia FROM JWST LESS THAN 0.075											

Proposal 8782 - Observation 11 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	<p>Proposal 8782, Observation 11: Sylvia</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 11:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Sylvia (Obs 11)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(5)	Sylvia	TYPE=ASTEROID,A=3.481867548313324,E=0.0927 3832403996568,I=10.87674252603503 .O=73.04710377946407,W=263.5299399254934,M=2 9.47461264157099,EQUINOX=J2000,EPOCH=05- MAR-2018:00:00:00,EpochTimeScale=TDB									
	<i>Comments: Extended=YES</i>											
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	G235M/F170LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.12
	2	G395M/F290LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.13
Special Requirements	DEFAULT WINDOW: ANGULAR RATE Sylvia FROM JWST LESS THAN 0.075											

Proposal 8782 - Observation 12 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	Proposal 8782, Observation 12: Angelina Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 12:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Angelina (Obs 12)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(4)	Angelina	TYPE=ASTEROID,A=2.682061017337263,E=0.1259 229852646316,I=1.309429328449573 ,O=309.1385747575252,W=178.7597481437618,M=2 59.8122059692456,EQUINOX=J2000,EPOCH=16- AUG-2017:00:00:00,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	G235M/F170LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.14
	2	G395M/F290LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.15
Special Requirements	DEFAULT WINDOW: ANGULAR RATE Angelina FROM JWST LESS THAN 0.075											

Proposal 8782 - Observation 13 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	<p>Proposal 8782, Observation 13: Aegle</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 13:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Aegle (Obs 13)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1				Level 2			Level 3		
	(6)	Aegle	TYPE=ASTEROID,A=3.050550926525714,E=0.1394 41362739715,I=15.96871181465607 ,O=321.6215233911414,W=208.9365614564554,M=3 43.3574580856379,EQUINOX=J2000,EPOCH=14- JUL-2017:00:00:00,EpochTimeScale=TDB									
	<i>Comments: Extended=Unknown</i>											
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	G235M/F170LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.16
	2	G395M/F290LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.17
Special Requirements	DEFAULT WINDOW: ANGULAR RATE Aegle FROM JWST LESS THAN 0.075											

Proposal 8782 - Observation 14 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	<p>Proposal 8782, Observation 14: Dembowska</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	<p>(Visit 14:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Dembowska (Obs 14)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
Solar System Targets	#	Name	Level 1				Level 2				Level 3	
	(10)	Dembowska	TYPE=ASTEROID,A=2.924081222631155,E=0.0915048417451164,I=8.246259994868856,O=32.34987096376179,W=346.1485932458316,M=348.7584827404064,EQUINOX=J2000,EPOCH=28-FEB-2017:00:00:00,EpochTimeScale=TDB									
	<i>Comments: Extended=Unknown</i>											
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	G235H/F170LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.18
	2	G395H/F290LP	NRSIRS2RAPID	5	1	false	true	NONE	4	4	350.133	227016.19
Special Requirements	DEFAULT WINDOW: ANGULAR RATE Dembowska FROM JWST LESS THAN 0.075											

Proposal 8782 - Observation 15 - Nominally anhydrous asteroids as reservoirs of water in the inner solar system

Tue Dec 16 22:00:27 GMT 2025

Observation	Proposal 8782, Observation 15: Astraea Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 15:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (Astraea (Obs 15)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
Solar System Targets	#	Name	Level 1				Level 2			Level 3		
	(1)	Astraea	TYPE=ASTEROID,A=2.573431161100588,E=0.1915 131708652443,I=5.367907898214483 .O=141.5841078022262,W=358.7833712899293,M=9 4.3757632772293,EQUINOX=J2000,EPOCH=01- MAR-2017:00:00:00,EpochTimeScale=TDB									
<i>Comments: Extended=Unknown</i>												
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	G235H/F170LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.21
	2	G395M/F290LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	227016.22
Special Requirements	DEFAULT WINDOW: ANGULAR RATE Astraea FROM JWST LESS THAN 0.075											