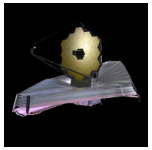

8445 - Complex Cyanides as Tracers for Unlocking the Chemical History of Trans-Neptunian Objects

Cycle: 4, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	3	1999OX3	NIRSpec Fixed Slit Spectroscopy	(3) 1999OX3
	4	1999RZ253	NIRSpec Fixed Slit Spectroscopy	(4) 1999RZ253
	9	2003GH55	NIRSpec Fixed Slit Spectroscopy	(9) 2003GH55
	12	2005EF298	NIRSpec Fixed Slit Spectroscopy	(12) 2005EF298
	16	2010VZ98	NIRSpec Fixed Slit Spectroscopy	(16) 2010VZ98

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	17	2008FC76	NIRSpec Fixed Slit Spectroscopy	(17) 2008FC76
	20	1999TC36	NIRSpec Fixed Slit Spectroscopy	(18) 1999TC36

ABSTRACT

Cyanides—compounds that contain one or more CN functional groups—have a ubiquitous presence in astrophysical environments. The CN functional group can be incorporated into a diverse range of molecular structures, from simpler cyanides like HCN to larger, more complex polymeric structures. These compounds form and evolve through thermal, photochemical, and irradiation-driven chemical pathways. As such, cyanides are key tracers of nitrogen chemistry in a wide range of astrophysical environments.

While CN-bearing species have been detected in comets, the moons of giant planets, and in micrometeorites, their presence on trans-Neptunian objects (TNOs) is poorly understood. This proposal aims to firmly detect complex cyanides TNOs and investigate their origin and evolution to shed light on the molecular diversity of the primordial Solar System. By linking the molecular composition of TNOs to that of other icy bodies like comets and moons, and interstellar structures such as molecular clouds, our study will bridge crucial gaps in understanding nitrogen chemistry across different environments.

We request observations of six medium-sized TNOs and one Centaur using the NIRSpec Fixed Slit (FS) mode to reach unprecedented high-SNR that only this observing mode of the JWST can reach. These observations will enable the robust detection of complex cyanides and associated molecules like N-H-bearing compounds and HCN, providing insights into the processes shaping N-bearing species in the Solar System. Ultimately, this work will enhance our understanding of the role of nitrogen in the emergence of biochemically relevant molecules, contributing to the broader field of astrobiology.

OBSERVING DESCRIPTION

We propose to observe seven outer Solar System objects using NIRSpec FS with the S200A1 slit and the Prism/CLEAR grating/filter pair to acquire low-resolving power spectra in the range 0.6-5.3micron. All targets, apart from 2008 FC76, were already observed in Cycle 1 (programs 2418) with NIRSpec IFU + Prism/CLEAR configuration. 2008 FC76 was observed as part of the GTO-KBOs project in medium resolution granting lower signal-to-noise ratio than the one aiming here. The choice of the FS + S200A1 + Prism/CLEAR configuration and the increase of the exposure time allow us to improve by a factor of ~3-4 the SNR around 4.5 μm, reaching a value of at least 20 for each target.
We have chosen the readout mode, the number of groups, the number of integrations, and the number of dither positions to maximize the SNR and minimized overheads, while avoiding saturation, integrations longer than 1500s, and data volume excess. For each target observed with PRISM in

previous cycles, the exposure time selected is more than 4 times longer than the exposure time of previous NIRSpec IFU + Prism/CLEAR observations.

All targets have rate motion far below the non-sidereal tracking limit of 0.075’’/sec and have observability in cycle-4 that avoids the MAZ and the galactic plane.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(3)	1999OX3	TYPE=ASTEROID,A=32.06648914393388,E=0.4516362474313739,I=2.624383961586907,O=259.1363697518559,W=144.5780345611612,M=346.1380577258965,EQUINOX=J2000,EPOCH=26-FEB-2017:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(4)	1999RZ253	TYPE=ASTEROID,A=43.55376244536579,E=0.08602817295110639,I=0.5632232651384337,O=84.74543180750533,W=194.8817057081767,M=60.37545278878972,EQUINOX=J2000,EPOCH=11-APR-2016:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(9)	2003GH55	TYPE=ASTEROID,A=44.31043918255283,E=0.08288538437446895,I=1.102219321607091,O=116.4519375308196,W=86.05074558667138,M=22.59031012813258,EQUINOX=J2000,EPOCH=20-JUN-2015:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(12)	2005EF298	TYPE=ASTEROID,A=44.33717130747964,E=0.0957619691154921,I=2.864244613050194,O=117.9685872316395,W=74.6756145599299,M=337.1076959588931,EQUINOX=J2000,EPOCH=25-OCT-2015:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(16)	2010VZ98	TYPE=ASTEROID,A=150.0972550655495,E=0.7712229228435676,I=4.511635362114131,O=117.3720212048757,W=313.8507284335299,M=358.1109334691189,EQUINOX=J2000,EPOCH=04-APR-2018:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(17)	2008FC76	TYPE=ASTEROID,A=14.69785329081857,E=0.3077502166329663,I=27.12959620424618,O=245.6713239260143,W=142.0608951439539,M=10.35166463114363,EQUINOX=J2000,EPOCH=02-NOV-2015:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(18)	1999TC36	TYPE=ASTEROID,A=39.20464457104811,E=0.2206965002912099,I=8.419618054407243,O=97.06171117853006,W=294.9451526887295,M=3.442553837583481,EQUINOX=J2000,EPOCH=25-AUG-2017:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				

Observation

Proposal 8445, Observation 3: 1999OX3

Thu Jan 08 19:00:12 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(1999OX3 (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)	1999OX3	TYPE=ASTEROID,A=32.06648914393388,E=0.4516362474313739,I=2.624383961586907,O=259.1363697518559,W=144.5780345611612,M=346.1380577258965,EQUINOX=J2000,EPOCH=26-FEB-2017:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPID	3	1	1	3.628	226151

Template

HFF Readout Mode	Slit	Subarray
false	S200A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	NONE

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	PRISM/CLEAR	S200A1	NRSIRS2RAPID	18	4	1	NONE	3	12	3326.267	

Special Requirements	DEFAULT WINDOW: ANGULAR RATE 1999OX3 FROM JWST LESS THAN 0.075

Observation

Proposal 8445, Observation 4: 1999RZ253

Thu Jan 08 19:00:12 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(1999RZ253 (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(4)	1999RZ253	TYPE=ASTEROID,A=43.55376244536579,E=0.0860 2817295110639,I=0.5632232651384337 ,O=84.74543180750533,W=194.8817057081767,M=6 0.37545278878972,EQUINOX=J2000,EPOCH=11-APR-2016:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPIDD6	3	1	1	14.452	226151

Template

HFF Readout Mode	Slit	Subarray
false	S200A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	NONE

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	PRISM/CLEAR	S200A1	NRSIRS2	20	6	1	NONE	3	18	26522.602	

Special Requirements	DEFAULT WINDOW: ANGULAR RATE 1999RZ253 FROM JWST LESS THAN 0.075

Observation

Proposal 8445, Observation 9: 2003GH55

Thu Jan 08 19:00:12 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 9:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(2003GH55 (Obs 9)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(9)	2003GH55	TYPE=ASTEROID,A=44.31043918255283,E=0.0828 8538437446895,I=1.102219321607091 ,O=116.4519375308196,W=86.05074558667138,M=2 2.59031012813258,EQUINOX=J2000,EPOCH=20- JUN-2015:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPIDD6	3	1	1	14.452	226151

Template

HFF Readout Mode	Slit	Subarray
false	S200A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	NONE

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	PRISM/CLEAR	S200A1	NRSIRS2	20	6	1	NONE	3	18	26522.602	

Special Requirements	DEFAULT WINDOW: ANGULAR RATE 2003GH55 FROM JWST LESS THAN 0.075

Observation

Proposal 8445, Observation 12: 2005EF298

Thu Jan 08 19:00:12 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 12:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(2005EF298 (Obs 12)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(12)	2005EF298	TYPE=ASTEROID,A=44.33717130747964,E=0.0957619691154921,I=2.864244613050194,O=117.9685872316395,W=74.6756145599299,M=337.1076959588931,EQUINOX=J2000,EPOCH=25-OCT-2015:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPIDD6	3	1	1	14.452	226151

Template

HFF Readout Mode	Slit	Subarray
false	S200A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	5	NONE

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	PRISM/CLEAR	S200A1	NRSIRS2	20	6	1	NONE	5	30	44204.337	

Special Requirements	DEFAULT WINDOW: ANGULAR RATE 2005EF298 FROM JWST LESS THAN 0.075

Observation

Proposal 8445, Observation 16: 2010VZ98

Thu Jan 08 19:00:12 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 16:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(2010VZ98 (Obs 16)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(16)	2010VZ98	TYPE=ASTEROID,A=150.0972550655495,E=0.7712229228435676,I=4.511635362114131,O=117.3720212048757,W=313.8507284335299,M=358.1109334691189,EQUINOX=J2000,EPOCH=04-APR-2018:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPID	3	1	1	3.628	226151

Template

HFF Readout Mode	Slit	Subarray
false	S200A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	NONE

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	PRISM/CLEAR	S200A1	NRSIRS2RAPID	22	5	1	NONE	3	15	5033.167	

Special Requirements	DEFAULT WINDOW: ANGULAR RATE 2010VZ98 FROM JWST LESS THAN 0.075

Observation

Proposal 8445, Observation 17: 2008FC76

Thu Jan 08 19:00:12 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 17:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(2008FC76 (Obs 17)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(17)	2008FC76	TYPE=ASTEROID,A=14.69785329081857,E=0.3077502166329663,I=27.12959620424618,O=245.6713239260143,W=142.0608951439539,M=10.35166463114363,EQUINOX=J2000,EPOCH=02-NOV-2015:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPIDD6	3	1	1	14.452	226151

Template

HFF Readout Mode	Slit	Subarray
false	S200A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	NONE

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	PRISM/CLEAR	S200A1	NRSIRS2RAPID	40	2	1	NONE	3	6	3588.867	

Special Requirements	
	Between Dates 13-MAR-2026:00:00:00 and 13-MAR-2026:18:09:00 Between Dates 13-MAR-2026:21:31:00 and 14-MAR-2026:13:06:00 Between Dates 14-MAR-2026:16:43:00 and 15-MAR-2026:22:19:00 Between Dates 16-MAR-2026:01:38:00 and 16-MAR-2026:15:56:00 Between Dates 16-MAR-2026:19:11:00 and 17-MAR-2026:06:38:00 Between Dates 17-MAR-2026:10:03:00 and 18-MAR-2026:18:59:00 Between Dates 18-MAR-2026:22:28:00 and 22-MAR-2026:00:00:00 Between Dates 25-MAR-2026:00:00:00 and 25-MAR-2026:08:51:00 Between Dates 25-MAR-2026:12:27:00 and 26-MAR-2026:00:00:00 Between Dates 18-APR-2026:00:00:00 and 20-APR-2026:00:00:00 DEFAULT WINDOW: ANGULAR RATE 2008FC76 FROM JWST LESS THAN 0.075

Observation

Proposal 8445, Observation 20: 1999TC36

Thu Jan 08 19:00:12 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 20:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(1999TC36 (Obs 20)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(18)	1999TC36	TYPE=ASTEROID,A=39.20464457104811,E=0.2206965002912099,I=8.419618054407243,O=97.06171117853006,W=294.9451526887295,M=3.442553837583481,EQUINOX=J2000,EPOCH=25-AUG-2017:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPID	3	1	1	3.628	226151

Template

HFF Readout Mode	Slit	Subarray
false	S200A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	NONE

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	PRISM/CLEAR	S200A1	NRSIRS2RAPID	15	6	1	NONE	3	18	4201.6	

Special Requirements	
	Between Dates 02-JAN-2026:00:00:00 and 04-JAN-2026:00:00:00 Between Dates 16-JAN-2026:00:00:00 and 19-JAN-2026:19:39:00 Between Dates 20-JAN-2026:01:05:00 and 21-JAN-2026:00:00:00 Between Dates 16-FEB-2026:00:00:00 and 20-FEB-2026:00:00:00 DEFAULT WINDOW: ANGULAR RATE 1999TC36 FROM JWST LESS THAN 0.075