



# 5940 - The missing link in the Kuiper belt: Reconnaissance spectroscopy of blue binary cold classical KBOs

Cycle: 3, Proposal Category: GO

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
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## OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
NIRSpec observations				
	1	2001XR254	NIRSpec IFU Spectroscopy	(1) 2001XR254
	2	2016BP81	NIRSpec IFU Spectroscopy	(2) 2016BP81
	3	2003HG57	NIRSpec IFU Spectroscopy	(3) 2003HG57

## ABSTRACT

Dynamical models of Neptune's early outward migration into the primordial transneptunian planetesimal disk have largely succeeded in reproducing the Kuiper belt's complex orbital architecture within the Kuiper belt. Meanwhile, volatile sublimation models have been developed to explain the color bimodality among the KBOs, with red and very-red objects forming in the inner and outer regions of the disk, respectively. The cold classical KBOs are distinguished by their low inclinations and high binary fraction. These findings have led many to posit that the cold classicals formed in situ in the outermost reaches of the protoplanetary disk. Most compositional models of the Kuiper belt predict that the cold classicals should all be very-red. However, recent observations have uncovered a significant population of bluer objects within the cold classical region that is dominated by binary systems. The presence of these blue binaries has challenged current theories of Kuiper belt formation and evolution. A fuller understanding of

their composition in the context of other KBO subpopulations has the potential to fundamentally reshape our understanding of the outer Solar System. A diverse sampling of KBOs have been observed in previous JWST cycles. Notably missing from these observations are the blue binaries, which constitute the only KBO subpopulation that has not been studied with JWST. In this proposal, we seek to fill in this gap by obtaining near-infrared spectra of three blue binaries in the cold classical population. When combined with the results of the previous programs, these spectra will complete the first comprehensive picture of Kuiper belt composition.

### **OBSERVING DESCRIPTION**

We will observe the 3 brightest blue binaries in the cold classical population of the Kuiper belt with the NIRSPec IFU. The targets are, in order of decreasing brightness, 2001 XR254, 2016 BP81, and 2003 HG57. The spectra will be obtained using the low-resolution PRISM grating, which will provide continuous coverage from 0.6 to 5.3 microns. These reconnaissance spectroscopic observations are designed to survey the volatile ice inventory on these objects and compare the spectra with extant datasets from various Cycle 1 and 2 programs targeting other subpopulations within the Kuiper belt. We target an SNR of 7 at 4.25 microns (carbon dioxide ice absorption), which will yield comparable sensitivity to other low-resolution spectra of KBOs from Cycle 1. Our observing strategy follows standard procedures for faint moving target observations. For each target, we will obtain a set of dithered single-integration exposures, utilizing the NRSIRS2RAPID readout and a 4-point dither pattern to minimize readout noise and detector effects. No target acquisition exposures are necessary.

Proposal 5940 - Targets - The missing link in the Kuiper belt: Reconnaissance spectroscopy of blue binary cold classical KBOs

Solar System Targets	#	Name	Level 1	Level 2	Level 3	
	(1)	2001XR254	TYPE=ASTEROID,A=43.12550726121993,E=0.0319 072798585212,I=1.231762931162009 .O=179.9597908740114,W=68.75020512936121,M=2 32.1749408645101,EQUINOX=J2000,EPOCH=01- MAR-2016:00:00:00,EpochTimeScale=TDB			
	<i>Comments: Extended=NO</i>					
	(2)	2016BP81	TYPE=ASTEROID,A=43.66276259201421,E=0.0737 668211037628,I=4.186628250414686 .O=28.99871901636635,W=274.0023396640233,M=6 5.12899741514016,EQUINOX=J2000,EPOCH=26- APR-2014:00:00:00,EpochTimeScale=TDB			
<i>Comments: Extended=NO</i>						
(3)	2003HG57	TYPE=ASTEROID,A=43.46319765441061,E=0.0300 6300037564475,I=2.101388069889179 .O=36.29599498942881,W=232.1205301288822,M=3 05.0872736320532,EQUINOX=J2000,EPOCH=24- FEB-2012:00:00:00,EpochTimeScale=TDB				
<i>Comments: Extended=NO</i>						

Proposal 5940 - Observation 1 - The missing link in the Kuiper belt: Reconnaissance spectroscopy of blue binary cold classical KBOs

Fri Mar 01 05:00:27 GMT 2024

<b>Observation</b>	Proposal 5940, Observation 1: 2001XR254 Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (2001XR254 (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
<b>Diagnosics</b>												
<b>Solar System Targets</b>	#	Name	Level 1				Level 2				Level 3	
	(1)	2001XR254	TYPE=ASTEROID,A=43.12550726121993,E=0.0319 072798585212,I=1.231762931162009 ,O=179.9597908740114,W=68.75020512936121,M=2 32.1749408645101,EQUINOX=J2000,EPOCH=01- MAR-2016:00:00:00,EpochTimeScale=TDB  Comments: Extended=NO									
<b>Template</b>	TA Method											
	NONE											
<b>Dithers</b>	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-DITHER										
<b>Spectral Elements</b>	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Ex p	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	PRISM/CLEAR	NRSIRS2RAPID	50	1	false	true	NONE	4	4	2976.134	
<b>Special Requirements</b>	DEFAULT WINDOW: ANGULAR RATE 2001XR254 FROM JWST LESS THAN 0.075											

Proposal 5940 - Observation 2 - The missing link in the Kuiper belt: Reconnaissance spectroscopy of blue binary cold classical KBOs

Fri Mar 01 05:00:27 GMT 2024

<b>Observation</b>	Proposal 5940, Observation 2: 2016BP81 Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (2016BP81 (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
<b>Diagnosics</b>												
<b>Solar System Targets</b>	#	Name	Level 1				Level 2				Level 3	
	(2)	2016BP81	TYPE=ASTEROID,A=43.66276259201421,E=0.0737 668211037628,I=4.186628250414686 ,O=28.99871901636635,W=274.0023396640233,M=6 5.12899741514016,EQUINOX=J2000,EPOCH=26- APR-2014:00:00:00,EpochTimeScale=TDB  Comments: Extended=NO									
<b>Template</b>	TA Method											
	NONE											
<b>Dithers</b>	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-DITHER										
<b>Spectral Elements</b>	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	PRISM/CLEAR	NRSIRS2RAPID	64	1	false	true	NONE	4	4	3793.111	
<b>Special Requirements</b>	DEFAULT WINDOW: ANGULAR RATE 2016BP81 FROM JWST LESS THAN 0.075											

Proposal 5940 - Observation 3 - The missing link in the Kuiper belt: Reconnaissance spectroscopy of blue binary cold classical KBOs

Fri Mar 01 05:00:27 GMT 2024

<b>Observation</b>	<p><b>Proposal 5940, Observation 3: 2003HG57</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
<b>Diagnostics</b>	<p>(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(2003HG57 (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>											
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>				<b>Level 2</b>				<b>Level 3</b>	
	(3)	2003HG57	TYPE=ASTEROID,A=43.46319765441061,E=0.0300 6300037564475,I=2.101388069889179 .O=36.29599498942881,W=232.1205301288822,M=3 05.0872736320532,EQUINOX=J2000,EPOCH=24- FEB-2012:00:00:00,EpochTimeScale=TDB									
	<i>Comments: Extended=NO</i>											
<b>Template</b>	<b>TA Method</b>											
	NONE											
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>		<b>Size</b>	<b>Starting Point</b>			<b>Number of Points</b>	<b>Points</b>			
	1	4-POINT-DITHER										
<b>Spectral Elements</b>	<b>#</b>	<b>Grating/Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Leakcal</b>	<b>Dither</b>	<b>Autocal</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	PRISM/CLEAR	NRSIRS2RAPID	85	1	false	true	NONE	4	4	5018.578	
<b>Special Requirements</b>	DEFAULT WINDOW: ANGULAR RATE 2003HG57 FROM JWST LESS THAN 0.075											