



# 5551 - Characterization of Water Outgassing in Main-Belt Comets 133P/Elst-Pizarro and 457P/Lemmon-PANSTARRS

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>
133P				
	1	133P - NIRCam	NIRCam Imaging	(1) 133P
	2	133P - NIRSpec	NIRSpec IFU Spectroscopy	(1) 133P
	3	133P - Background - NIRSpec	NIRSpec IFU Spectroscopy	(1) 133P
457P				
	4	457P - NIRCam	NIRCam Imaging	(2) 457P
	5	457P - NIRSpec	NIRSpec IFU Spectroscopy	(2) 457P
	6	457P - Background - NIRSpec	NIRSpec IFU Spectroscopy	(2) 457P

## ABSTRACT

Current small solar system body research suggests that comets and asteroids occupy a continuum, and that inner solar system objects (with orbits inside the orbit of Jupiter) may contain substantial extant ice. This work has profound implications for models of the origin and evolution of water,

volatiles, and organics in our solar system. We request JWST GO time to characterize the volatile content of two main-belt comets (MBCs), which are small bodies that orbit in the main asteroid belt yet exhibit comet-like activity (implying the presence of ice), with NIRCams and NIRSpec. With NIRSpec observations proposed here, we will be able to detect water gas production rates from MBCs 133P/Elst-Pizarro and 457P/Lemmon-PANSTARRS as low as  $\sim 10^{23}$  molecules/s (5-sigma), exceeding pre-JWST upper limits by three orders of magnitude. NIRCams imaging will allow us to characterize the spatial distributions of our targets' gas and dust comae, providing insights into ejection mechanisms and active area distributions. Together with completed or upcoming Cycle 1 and 2 observations of MBCs, our proposed Cycle 3 observations will address scientific questions about how physical or dynamical properties or orbital circumstances affect outgassing properties, and also facilitate the leveraging of JWST results to the large body of available ground-based MBC data by improving our understanding of the relationship of JWST-derived water production rates to visible dust production rates.

### **OBSERVING DESCRIPTION**

We plan to observe two main-belt comets, 133P and 457P, while they are expected to be active. We request both NIRCams and NIRSpec IFU prism mode observations, both of which will be used to detect water vapor at 2.7 microns in the coma. NIRSpec observations have dedicated background. The NIRCams background can be derived in-scene or from the other module.

#### Special requirements

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\*\* Timing constraints so the observations are executed when the comets are active.

\*\* Offsets for NIRCams to place the targets in detector B1.

\*\* Offsets for NIRSpec backgrounds to nod the telescope to nearby blank sky.

\*\* Timing constraints so that the NIRCams - NIRSpec source - NIRSpec background sequence for each target is executed as a non-interruptible sequence.

Proposal 5551 - Targets - Characterization of Water Outgassing in Main-Belt Comets 133P/Elst-Pizarro and 457P/Lemmon-PANSTAR...

Solar System Targets	#	Name	Level 1	Level 2	Level 3
	(1)	133P	TYPE=COMET,Q=2.652791008311603,E=0.1605506 542499956,I=1.387313927713718 ,O=160.1361758363344,W=131.9620696763533,T=20 -SEP- 2018:23:05:31,TTIMEscale=TDB,EQUINOX=J2000,E POCH=15-FEB-2016:00:00:00,EpochTimeScale=TDB		
<i>Comments: Extended=YES</i>					
(2)	457P	TYPE=COMET,Q=2.32884195979451,E=0.11958279 37439562,I=5.22499735454285 ,O=175.9775668839289,W=104.6948524099529,T=03 -MAY- 2020:06:36:39,TTIMEscale=TDB,EQUINOX=J2000,E POCH=22-DEC-2020:00:00:00,EpochTimeScale=TDB			
<i>Comments: Extended=YES</i>					

Proposal 5551 - Observation 1 - Characterization of Water Outgassing in Main-Belt Comets 133P/Elst-Pizarro and 457P/Lemmon-PA...

Tue Sep 10 20:00:30 GMT 2024

<b>Observation</b>	Proposal 5551, Observation 1: 133P - NIRCam Diagnostic Status: Warning Observing Template: NIRCam Imaging									
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (133P - NIRCam (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
<b>Diagnosics</b>										
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>	<b>Level 2</b>			<b>Level 3</b>			
	(1)	133P	TYPE=COMET,Q=2.652791008311603,E=0.1605506 542499956,I=1.387313927713718 .O=160.1361758363344,W=131.9620696763533,T=20 -SEP- 2018:23:05:31,TTimeScale=TDB,EQUINOX=J2000,E POCH=15-FEB-2016:00:00:00,EpochTimeScale=TDB  <i>Comments: Extended=YES</i>							
<b>Template</b>	<b>Module</b>				<b>Subarray</b>					
	B				FULL					
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>	<b>Primary Dithers</b>	<b>Subpixel Dither Type</b>	<b>Dither Size</b>	<b>Subpixel Positions</b>				
	1	INTRAMODULEBOX	4	STANDARD		1				
<b>Spectral Elements</b>	<b>#</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F200W	F277W	SHALLOW4	5	2	8	4	2104.407	174560
<b>Special Requirements</b>	Between Dates 16-SEP-2024:00:00:00 and 11-NOV-2024:00:00:00 Offset 37.0 arcsec, 37.0 arcsec  Group Observations 1, 2, 3, Non-interruptible  DEFAULT WINDOW: ANGULAR RATE 133P FROM JWST LESS THAN 0.075									

Proposal 5551 - Observation 2 - Characterization of Water Outgassing in Main-Belt Comets 133P/Elst-Pizarro and 457P/Lemmon-PA...

Tue Sep 10 20:00:30 GMT 2024

<b>Observation</b>	Proposal 5551, Observation 2: 133P - NIRSpec Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (133P - NIRSpec (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	
	(1)	133P	TYPE=COMET,Q=2.652791008311603,E=0.1605506 542499956,I=1.387313927713718 ,O=160.1361758363344,W=131.9620696763533,T=20 -SEP- 2018:23:05:31,TimeScale=TDB,EQUINOX=J2000,E POCH=15-FEB-2016:00:00:00,EpochTimeScale=TDB  Comments: Extended=YES									
<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	25	2	false	true	NONE	4	8	3034.489	174560
<b>Special Requirements</b>	Between Dates 16-SEP-2024:00:00:00 and 11-NOV-2024:00:00:00											
	Group Observations 1, 2, 3, Non-interruptible DEFAULT WINDOW: ANGULAR RATE 133P FROM JWST LESS THAN 0.075											

Proposal 5551 - Observation 3 - Characterization of Water Outgassing in Main-Belt Comets 133P/Elst-Pizarro and 457P/Lemmon-PA...

Tue Sep 10 20:00:30 GMT 2024

<b>Observation</b>	Proposal 5551, Observation 3: 133P - Background - NIRSpec <b>Diagnostic Status: Warning</b> Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (133P - Background - NIRSpec (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
<b>Diagnosics</b>												
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>				<b>Level 2</b>				<b>Level 3</b>	
	(1)	133P	TYPE=COMET,Q=2.652791008311603,E=0.1605506 542499956,I=1.387313927713718 ,O=160.1361758363344,W=131.9620696763533,T=20 -SEP- 2018:23:05:31,TTimeScale=TDB,EQUINOX=J2000,E POCH=15-FEB-2016:00:00:00,EpochTimeScale=TDB  Comments: Extended=YES									
<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-NOD										
<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	25	2	false	true	NONE	4	8	3034.489	174560
<b>Special Requirements</b>	Between Dates 16-SEP-2024:00:00:00 and 11-NOV-2024:00:00:00 Offset 45.0 arcsec, 45.0 arcsec  Group Observations 1, 2, 3, Non-interruptible  DEFAULT WINDOW: ANGULAR RATE 133P FROM JWST LESS THAN 0.075											

Proposal 5551 - Observation 4 - Characterization of Water Outgassing in Main-Belt Comets 133P/Elst-Pizarro and 457P/Lemmon-PA...

Tue Sep 10 20:00:30 GMT 2024

<b>Observation</b>	Proposal 5551, Observation 4: 457P - NIRCam Diagnostic Status: Warning Observing Template: NIRCam Imaging									
	(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (457P - NIRCam (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.									
<b>Diagnosics</b>										
<b>Solar System Targets</b>	<b>#</b>	<b>Name</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>					
	(2)	457P	TYPE=COMET,Q=2.32884195979451,E=0.11958279 37439562,I=5.22499735454285 .O=175.9775668839289,W=104.6948524099529,T=03 -MAY- 2020:06:36:39,TimeScale=TDB,EQUINOX=J2000,E POCH=22-DEC-2020:00:00:00,EpochTimeScale=TDB				Comments: Extended=YES			
<b>Template</b>	<b>Module</b>			<b>Subarray</b>						
	B			FULL						
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>	<b>Primary Dithers</b>	<b>Subpixel Dither Type</b>	<b>Dither Size</b>	<b>Subpixel Positions</b>				
	1	INTRAMODULEBOX	4	STANDARD		1				
<b>Spectral Elements</b>	<b>#</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F200W	F277W	SHALLOW4	5	2	8	4	2104.407	174560
<b>Special Requirements</b>	Between Dates 21-JUL-2024:00:00:00 and 22-SEP-2024:00:00:00 Offset 37.0 arcsec, 37.0 arcsec  DEFAULT WINDOW: ANGULAR RATE 457P FROM JWST LESS THAN 0.075									

Proposal 5551 - Observation 5 - Characterization of Water Outgassing in Main-Belt Comets 133P/Elst-Pizarro and 457P/Lemmon-PA...

Tue Sep 10 20:00:30 GMT 2024

<b>Observation</b>	Proposal 5551, Observation 5: 457P - NIRSpec Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (457P - NIRSpec (Obs 5)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.											
<b>Solar System Targets</b>	#	Name	Level 1				Level 2				Level 3	
	(2)	457P	TYPE=COMET,Q=2.32884195979451,E=0.11958279 37439562,I=5.22499735454285 ,O=175.9775668839289,W=104.6948524099529,T=03 -MAY- 2020:06:36:39,TimeScale=TDB,EQUINOX=J2000,E POCH=22-DEC-2020:00:00:00,EpochTimeScale=TDB  Comments: Extended=YES									
<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	25	2	false	true	NONE	4	8	3034.489	174560
<b>Special Requirements</b>	Between Dates 21-JUL-2024:00:00:00 and 22-SEP-2024:00:00:00											
	DEFAULT WINDOW: ANGULAR RATE 457P FROM JWST LESS THAN 0.075											

Proposal 5551 - Observation 6 - Characterization of Water Outgassing in Main-Belt Comets 133P/Elst-Pizarro and 457P/Lemmon-PA...

Tue Sep 10 20:00:30 GMT 2024

<b>Observation</b>	Proposal 5551, Observation 6: 457P - Background - NIRSpec Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy											
	(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. (457P - Background - NIRSpec (Obs 6)) 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)	457P	TYPE=COMET,Q=2.32884195979451,E=0.11958279 37439562,I=5.22499735454285 ,O=175.9775668839289,W=104.6948524099529,T=03 -MAY- 2020:06:36:39,TimeScale=TDB,EQUINOX=J2000,E POCH=22-DEC-2020:00:00:00,EpochTimeScale=TDB  Comments: Extended=YES									
<b>Template</b>	TA Method											
	NONE											
<b>Dithers</b>	#	Dither Type		Size		Starting Point		Number of Points		Points		
	1	4-POINT-NOD										
<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	25	2	false	true	NONE	4	8	3034.489	174560
<b>Special Requirements</b>	Between Dates 21-JUL-2024:00:00:00 and 22-SEP-2024:00:00:00 Offset 45.0 arcsec, 45.0 arcsec  DEFAULT WINDOW: ANGULAR RATE 457P FROM JWST LESS THAN 0.075											