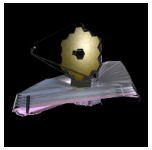

# 4250 - Characterization of Water Outgassing in Main-Belt Comets 133P/Elst-Pizarro and 358P/PANSTARRS

Cycle: 2, Proposal Category: GO

**INVESTIGATORS**


| *Name* | *Institution* |
|---|---|
| **Dr. Henry H. Hsieh (PI)** | **Planetary Science Institute** |
| Dr. Michael S Kelley (CoI) | University of Maryland |
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| Dr. John W Noonan (CoI) | Auburn University |


**OBSERVATIONS**

| *Folder* | *Observation* | *Label* | *Observing Template* | *Science Target* |
|---|---|---|---|---|
| 133P | | | | |
| | 1 | 133P - NIRCam | NIRCam Imaging | (1) 133P |
| | 7 | 133P - NIRCam | NIRCam Imaging | (1) 133P |
| | 2 | 133P - NIRSpec | NIRSpec IFU Spectroscopy | (1) 133P |
| | 3 | 133P - Background - NIRSpec | NIRSpec IFU Spectroscopy | (1) 133P |
| 358P | | | | |
| | 4 | 358P - NIRCam | NIRCam Imaging | (2) 358P |
| | 5 | 358P - NIRSpec | NIRSpec IFU Spectroscopy | (2) 358P |
| | 6 | 358P - Background - NIRSpec | NIRSpec IFU Spectroscopy | (2) 358P |

**ABSTRACT**

Current research on small bodies in the solar system suggests that there is a continuum between comets and asteroids, and that the dynamical properties of a small body are not enough to predict the volatile content of an object. These questions are profound for our models of the origin and distribution and of water, volatiles, and organics in our solar system. We request JWST General Observer time to characterize the volatile content of two main-belt comets (MBCs), which are small bodies with asteroid-like orbits that exhibit comet-like activity, with NIRCam and NIRSpec. With observations of MBCs 133P/Elst-Pizarro and 358P/PANSTARRS that we propose here, we will be able to detect water gas production rates as low as 1e24 molecules/s (5-sigma), exceeding pre-JWST upper limits by almost two orders of magnitude. This capability was demonstrated by JWST/NIRSpec's recent successful detection of water gas production in MBC 238P/Read, which was the first successful spectroscopic detection of volatile sublimation for a MBC ever. NIRCam imaging will also allow us to search for morphology differences between our targets' gas and dust comae, providing insights into ejection mechanisms and distribution of active sites on each object. JWST observations of two more MBCs would triple the number of meaningful direct measurements of outgassing rates around small (km-scale) asteroids, and significantly advance our understanding of the diversity of the MBC population.

**OBSERVING DESCRIPTION**

We plan to observe two main-belt comets, 133P and 358P, while they are expected to be active. We request both NIRCam and NIRSpec IFU prism mode observations, both of which will be used to detect water vapor at 2.7 microns in the coma. The NIRSpec observation has a dedicated background. The NIRCam 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 NIRCam to place the targets in detector B1.

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

** Timing contraints so that the NIRSpec source - NIRSpec background sequence is execute as a non-interruptible sequence.

**Solar System Targets**

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (1) | 133P | TYPE=COMET,Q=2.6525981159533,E=0.160584885<br>1360985,I=1.387284606413598<br>,O=160.1371757432742,W=131.9669803271283,T=20<br>-SEP-<br>2018:22:59:02,TTimeScale=TDB,EQUINOX=J2000,E<br>POCH=29-JAN-2016:00:00:00,EpochTimeScale=TDB | | |
| *Comments: Extended=YES* | | | | |
| (2) | 358P | TYPE=COMET,Q=2.401211050788354,E=0.2377095<br>280103813,I=11.05720489782846<br>,O=85.72031790819241,W=299.8156537307482,T=11<br>-APR-<br>2018:09:24:00,TTimeScale=TDB,EQUINOX=J2000,E<br>POCH=24-JUL-<br>2019:00:00:00,EpochTimeScale=TDB,R0=2.808<br>,DT=0.<br>,A1=0.,A2=-2.315497025847E-10,A3=0.<br>,ALN=0.1112620426,NM=2.15,NN=5.093,NK=4.6142<br>,AMRAT=0. | | |
| *Comments: Extended=YES* | | | | |

## Observation

**Proposal 4250, Observation 1: 133P - NIRCam**

Wed Jul 03 15:03:39 GMT 2024

**Diagnostic Status: Warning**

Observing Template: NIRCam Imaging

## Diagnostics

(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.

## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (1) | 133P | TYPE=COMET,Q=2.6525981159533,E=0.160584885<br>1360985,I=1.387284606413598<br>,O=160.1371757432742,W=131.9669803271283,T=20<br>-SEP-<br>2018:22:59:02,TTimeScale=TDB,EQUINOX=J2000,E<br>POCH=29-JAN-2016:00:00:00,EpochTimeScale=TDB | | |

*Comments: Extended=YES*

## Template

| Module | Subarray |
|---|---|
| B | FULL |

## Dithers

| # | Primary Dither Type | Primary Dithers | Subpixel Dither Type | Dither Size | Subpixel Positions |
|---|---|---|---|---|---|
| 1 | INTRAMODULEBOX | 4 | STANDARD | | 1 |

## Spectral Elements

| # | Short Filter | Long Filter | Readout Pattern | Groups/Int | Integrations/Exp | Total Integrations | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F200W | F277W | SHALLOW4 | 5 | 1 | 4 | 4 | 1030.73 | 147338.11 |

## Special Requirements

Between Dates 26-APR-2024:00:00:00 and 25-JUN-2024:00:00:00
Offset 38.0 arcsec, 38.0 arcsec

DEFAULT WINDOW: ANGULAR RATE 133P FROM JWST LESS THAN 0.075

## Observation

**Proposal 4250, Observation 7: 133P - NIRCam** Wed Jul 03 15:03:39 GMT 2024

**Diagnostic Status: Warning**

Observing Template: NIRCam Imaging

## Diagnostics

(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(133P - NIRCam (Obs 7)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (1) | 133P | TYPE=COMET,Q=2.6525981159533,E=0.160584885<br>1360985,I=1.387284606413598<br>,O=160.1371757432742,W=131.9669803271283,T=20<br>-SEP-<br>2018:22:59:02,TTimeScale=TDB,EQUINOX=J2000,E<br>POCH=29-JAN-2016:00:00:00,EpochTimeScale=TDB | | |

*Comments: Extended=YES*

## Template

| Module | Subarray |
|---|---|
| B | FULL |

## Dithers

| # | Primary Dither Type | Primary Dithers | Subpixel Dither Type | Dither Size | Subpixel Positions |
|---|---|---|---|---|---|
| 1 | INTRAMODULEBOX | 4 | STANDARD | | 1 |

## Spectral Elements

| # | Short Filter | Long Filter | Readout Pattern | Groups/Int | Integrations/Exp | Total Integrations | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F200W | F277W | SHALLOW4 | 5 | 1 | 4 | 4 | 1030.73 | 147338.11 |

## Special Requirements

Between Dates 16-SEP-2024:00:00:00 and 11-NOV-2024:00:00:00
Offset 38.0 arcsec, 38.0 arcsec

DEFAULT WINDOW: ANGULAR RATE 133P FROM JWST LESS THAN 0.075

## Observation

**Proposal 4250, Observation 2: 133P - NIRSpec**

Wed Jul 03 15:03:39 GMT 2024

**Diagnostic Status: Warning**

Observing Template: NIRSpec IFU Spectroscopy

## Diagnostics

(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.

## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (1) | 133P | TYPE=COMET,Q=2.6525981159533,E=0.160584885<br>1360985,I=1.387284606413598<br>,O=160.1371757432742,W=131.9669803271283,T=20<br>-SEP-<br>2018:22:59:02,TTimeScale=TDB,EQUINOX=J2000,E<br>POCH=29-JAN-2016:00:00:00,EpochTimeScale=TDB | | |

*Comments: Extended=YES*

## Template

| TA Method |
|---|
| NONE |

## 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 | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PRISM/CLEAR | NRSIRS2RAPID | 50 | 1 | false | true | NONE | 4 | 4 | 2976.134 | |

## Special Requirements

Between Dates 26-APR-2024:00:00:00 and 25-JUN-2024:00:00:00

Sequence Observations 2, 3, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE 133P FROM JWST LESS THAN 0.075

## Observation

**Proposal 4250, Observation 3: 133P - Background - NIRSpec** Wed Jul 03 15:03:39 GMT 2024

**Diagnostic Status: Warning**

Observing Template: NIRSpec IFU Spectroscopy

## Diagnostics

(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.

## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (1) | 133P | TYPE=COMET,Q=2.6525981159533,E=0.160584885<br>1360985,I=1.387284606413598<br>,O=160.1371757432742,W=131.9669803271283,T=20<br>-SEP-<br>2018:22:59:02,TTimeScale=TDB,EQUINOX=J2000,E<br>POCH=29-JAN-2016:00:00:00,EpochTimeScale=TDB | | |

*Comments: Extended=YES*

## Template

| TA Method |
|---|
| NONE |

## Dithers

| # | Dither Type | Size | Starting Point | Number of Points | Points |
|---|---|---|---|---|---|
| 1 | 4-POINT-NOD | | | | |

## Spectral Elements

| # | 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 | 50 | 1 | false | true | NONE | 4 | 4 | 2976.134 | |

## Special Requirements

Between Dates 26-APR-2024:00:00:00 and 25-JUN-2024:00:00:00
Offset 45.0 arcsec, 45.0 arcsec

Sequence Observations 2, 3, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE 133P FROM JWST LESS THAN 0.075

## Observation

**Proposal 4250, Observation 4: 358P - NIRCam**

Wed Jul 03 15:03:39 GMT 2024

**Diagnostic Status: Warning**

Observing Template: NIRCam Imaging

## Diagnostics

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

(358P - NIRCam (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (2) | 358P | TYPE=COMET,Q=2.401211050788354,E=0.2377095<br>280103813,I=11.05720489782846<br>,O=85.72031790819241,W=299.8156537307482,T=11<br>-APR-<br>2018:09:24:00,TTimeScale=TDB,EQUINOX=J2000,E<br>POCH=24-JUL-<br>2019:00:00:00,EpochTimeScale=TDB,R0=2.808<br>,DT=0.<br>,A1=0.,A2=-2.315497025847E-10,A3=0.<br>,ALN=0.1112620426,NM=2.15,NN=5.093,NK=4.6142<br>,AMRAT=0. | | |

*Comments: Extended=YES*

## Template

| Module | Subarray |
|---|---|
| B | FULL |

## Dithers

| # | Primary Dither Type | Primary Dithers | Subpixel Dither Type | Dither Size | Subpixel Positions |
|---|---|---|---|---|---|
| 1 | INTRAMODULEBOX | 4 | STANDARD | | 1 |

## Spectral Elements

| # | Short Filter | Long Filter | Readout Pattern | Groups/Int | Integrations/Exp | Total Integrations | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F200W | F277W | SHALLOW4 | 5 | 1 | 4 | 4 | 1030.73 | 147338.8 |

## Special Requirements

Between Dates 17-NOV-2023:00:00:00 and 17-JAN-2024:00:00:00
Offset 38.0 arcsec, 38.0 arcsec

DEFAULT WINDOW: ANGULAR RATE 358P FROM JWST LESS THAN 0.075

## Observation

**Proposal 4250, Observation 5: 358P - NIRSpec**

Wed Jul 03 15:03:39 GMT 2024

**Diagnostic Status: Warning**

Observing Template: NIRSpec IFU Spectroscopy

## Diagnostics

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(358P - NIRSpec (Obs 5)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (2) | 358P | TYPE=COMET,Q=2.401211050788354,E=0.2377095<br>280103813,I=11.05720489782846<br>,O=85.72031790819241,W=299.8156537307482,T=11<br>-APR-<br>2018:09:24:00,TTimeScale=TDB,EQUINOX=J2000,E<br>POCH=24-JUL-<br>2019:00:00:00,EpochTimeScale=TDB,R0=2.808<br>,DT=0.<br>,A1=0.,A2=-2.315497025847E-10,A3=0.<br>,ALN=0.1112620426,NM=2.15,NN=5.093,NK=4.6142<br>,AMRAT=0. | | |

*Comments: Extended=YES*

## Template

| TA Method |
|---|
| NONE |

## 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 | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PRISM/CLEAR | NRSIRS2RAPID | 50 | 1 | false | true | NONE | 4 | 4 | 2976.134 | |

## Special Requirements

Between Dates 17-NOV-2023:00:00:00 and 17-JAN-2024:00:00:00

Sequence Observations 5, 6, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE 358P FROM JWST LESS THAN 0.075

## Observation

**Proposal 4250, Observation 6: 358P - Background - NIRSpec**

Wed Jul 03 15:03:39 GMT 2024

**Diagnostic Status: Warning**

Observing Template: NIRSpec IFU Spectroscopy

## Diagnostics

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(358P - Background - NIRSpec (Obs 6)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (2) | 358P | TYPE=COMET,Q=2.401211050788354,E=0.2377095<br>280103813,I=11.05720489782846<br>,O=85.72031790819241,W=299.8156537307482,T=11<br>-APR-<br>2018:09:24:00,TTimeScale=TDB,EQUINOX=J2000,E<br>POCH=24-JUL-<br>2019:00:00:00,EpochTimeScale=TDB,R0=2.808<br>,DT=0.<br>,A1=0.,A2=-2.315497025847E-10,A3=0.<br>,ALN=0.1112620426,NM=2.15,NN=5.093,NK=4.6142<br>,AMRAT=0. | | |

*Comments: Extended=YES*

## Template

| TA Method |
|---|
| NONE |

## Dithers

| # | Dither Type | Size | Starting Point | Number of Points | Points |
|---|---|---|---|---|---|
| 1 | 4-POINT-NOD | | | | |

## Spectral Elements

| # | 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 | 50 | 1 | false | true | NONE | 4 | 4 | 2976.134 | |

## Special Requirements

Between Dates 17-NOV-2023:00:00:00 and 17-JAN-2024:00:00:00
Offset 45.0 arcsec, 45.0 arcsec

Sequence Observations 5, 6, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE 358P FROM JWST LESS THAN 0.075