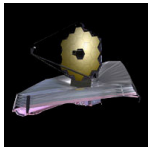

4621 - Time-sensitive observations of Chiron: a unique active Centaur beyond 15 AU

Cycle: 2, Proposal Category: DD

INVESTIGATORS

Name	*Institution*
Dr. Ian Wong (PI)	**NASA Goddard Space Flight Center**
Dr. Silvia Protopapa (CoI) (CoPI)	Southwest Research Institute
Dr. Geronimo Villanueva (CoI)	NASA Goddard Space Flight Center
Dr. Aurelie Guilbert-Lepoutre (CoI) (ESA Member)	Universite Claude Bernard Lyon 1
Dr. Rosario Brunetto (CoI) (ESA Member)	Institut d'Astrophysique Spatiale
Dr. Ana Carolina de Souza Feliciano (CoI)	University of Central Florida Board of Trustees
Dr. Joshua P Emery (CoI)	Northern Arizona University
Dra. Estela Fernandez-Valenzuela (CoI)	University of Central Florida Board of Trustees
Dr. Bryan Jason Holler (CoI)	Space Telescope Science Institute
Dr. Noemi Pinilla-Alonso (CoI)	University of Central Florida Board of Trustees
Dr. John A. Stansberry (CoI)	Space Telescope Science Institute

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Chiron				
	1	CHIRON	NIRSpec IFU Spectroscopy	(1) CHIRON
	2	CHIRON BKG	NIRSpec IFU Spectroscopy	(2) CHIRON-OFFSET

ABSTRACT

Chiron is the one of the largest known Centaurs, i.e., inward-scattered objects from the Kuiper belt that reside in the giant planet region. As it was approaching aphelion at 18.8 AU in March 2021, Chiron experienced an outburst of cometary activity. A subsequent JWST observation in July 2023,

obtained as part of a Cycle 1 GTO program, revealed evidence of methane and carbon dioxide outgassing and a perplexing absence of carbon monoxide emission. The unique spectral characteristics and extreme heliocentric distance of Chiron during its current active phase challenge our current understanding of distant cometary activity. Unfortunately, the July 2023 JWST spectrum does not have the requisite spectral resolution and sensitivity to enable proper assessment of Chiron's gas emission and coma properties. Continued photometric monitoring of Chiron since the 2021 outburst shows that its activity level is in a steady decline, and we propose to obtain DDT observations of Chiron during its next visibility window (November 2023-January 2024) to carry out timely intensive spectroscopic study before its activity subsides. We will leverage the high spectral resolution of the G395H grating to fully resolve the gas emission bands and derive precise constraints on the production rates. Accompanying exposures with the G235M grating will provide crucial information about the abundance of carbon dioxide ice on the surface and within the coma. The insights gleaned from these observations have the potential to reshape our fundamental understanding of the chemical composition and thermal evolution of distant planetesimals.

OBSERVING DESCRIPTION

To investigate the spectral features of gas- and solid-phase molecules and explore their spatial distributions, we plan to observe Chiron with the NIRSpec IFU. Long exposures with the G395H grating will provide the necessary spectral resolution to resolve individual gas emission lines and provide enhanced sensitivity to fine spatial structures in the surrounding coma. We will also collect exposures with the lower-resolution G235M grating to measure the spectral profile of the various carbon dioxide ice absorptions at 1.8-2.1 and 2.6-2.8 microns and map their spatial distribution. The NRSIRS2RAPID readout mode is chosen to increase the signal-to-noise ratio of these observations, while the four-point dither will help mitigate the effects of cosmic rays and detector artifacts. Given the extended coma around Chiron, we will obtain a dedicated background observation with the G395H grating immediately following the on-source observation.

Proposal 4621 - Targets - Time-sensitive observations of Chiron: a unique active Centaur beyond 15 AU

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	CHIRON	TYPE=ASTEROID,A=13.71302662009106,E=0.3763536766856216,I=6.91670262047946,O=209.3080317470092,W=339.3641100580242,M=196.6992889854017,EQUINOX=J2000,EPOCH=01-SEP-2023:00:00:00,EpochTimeScale=TDB		
Comments: Extended=YES				
(2)	CHIRON-OFFSET	TYPE=ASTEROID,A=13.71302662009106,E=0.3763536766856216,I=6.91670262047946,O=209.3080317470092,W=339.3641100580242,M=196.6992889854017,EQUINOX=J2000,EPOCH=01-SEP-2023:00:00:00,EpochTimeScale=TDB	TYPE=POS_ANGLE,RAD=60,ANG=90,REF=NORTH	
Comments: Extended=Unknown				

Observation

Proposal 4621, Observation 1: CHIRON

Wed Jan 03 19:00:57 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

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

(CHIRON (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)	CHIRON	TYPE=ASTEROID,A=13.71302662009106,E=0.3763536766856216,I=6.91670262047946,O=209.3080317470092,W=339.3641100580242,M=196.6992889854017,EQUINOX=J2000,EPOCH=01-SEP-2023:00:00:00,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	G235M/F170LP	NRSIRS2RAPID	19	1	false	true	NONE	4	4	1167.111	
2	G395H/F290LP	NRSIRS2RAPID	41	1	false	true	NONE	4	4	2450.934	

Special Requirements

Sequence Observations 1, 2, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE CHIRON FROM JWST LESS THAN 0.075

Observation

Proposal 4621, Observation 2: CHIRON BKG Wed Jan 03 19:00:57 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.

(CHIRON BKG (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(2)	CHIRON-OFFSET	TYPE=ASTEROID,A=13.71302662009106,E=0.3763536766856216,I=6.91670262047946,O=209.3080317470092,W=339.3641100580242,M=196.6992889854017,EQUINOX=J2000,EPOCH=01-SEP-2023:00:00:00,EpochTimeScale=TDB	TYPE=POS_ANGLE,RAD=60,ANG=90,REF=NORTH	

Comments: Extended=Unknown

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	2-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	G235M/F170LP	NRSIRS2RAPID	19	1	false	true	NONE	2	2	583.556	
2	G395H/F290LP	NRSIRS2RAPID	41	1	false	true	NONE	2	2	1225.467	

Special Requirements

Sequence Observations 1, 2, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE CHIRON-OFFSET FROM JWST LESS THAN 0.075