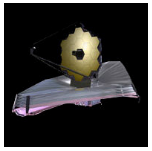

9441 - Enabling early decision making for a possible lunar impact in 2032

Cycle: 4, Proposal Category: DD

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
NIRCam				
	1		NIRCam Imaging	(1) 2024YR4
	2		NIRCam Imaging	(1) 2024YR4

ABSTRACT

We request observations of asteroid 2024 YR4 (“YR4”) in Spring 2026 to provide essential early information about its possible lunar impact in 2032. JWST's recent observations of YR4 improved predictions of its future positions and yielded a region of probability now including the Moon (uncertainty region size: 23,000 km, impact probability: 4%). They also yielded a size of 60 m that translates into an 6 megaton TNT-equivalent impact energy, expected to liberate dust producing years of equivalent background meteoroid impact exposure to Earth’s satellites within only a few days. In contrast to the localized effects of a 60 m Earth impactor, the evolution of ejected dust in the Earth–Moon system could make a 60-m lunar impactor significant for Earth’s entire population. On the positive side, if YR4 is expected to hit the Moon, the scientific community may use the opportunity to prepare before-and-after studies.

JWST is the only facility that can obtain new positional data for YR4 prior to 2028. Additional positional data will change the impact probability as the uncertainty region shrinks due to new data, and if those new data change the nominal distance from YR4 to the center of the Moon at close approach. Taking both factors into account, we estimate that the proposed JWST observations have an 80% chance of reducing the impact probability to < 1%, with an 5% probability that it will increase to > 30%. In both of those cases, decision makers will have a clearer path ahead. Regardless of the outcome, these observations will also serve as a proof-of-concept for future risk-assessment programs for possible impactors to be soon identified by the Vera C. Rubin Observatory.

OBSERVING DESCRIPTION

We request five hours of NIRCam imaging of 2024 YR4, with a goal of extracting positional information that will extend its observational arc from 4.5 months to 14 months and decrease the size of its uncertainty region at the time of a possible lunar impact by a factor of ~10. In order to obtain high quality (precision ~0.1 arcsecond) accuracy on a faint, moving target like YR4, we require at least 4 Gaia stars in the same FOV as YR4 for a significant fraction of the observing time. In order to maximize SNR in limited time, we aim to use the short-wavelength side of NIRCam to obtain the positions. We derive 5 hours of exposure time as the necessary length in order to reach SNR ~ 5 for YR4, which is at V ~ 30, through the F150W2 filter. This also provides SNR ~ 2 through the F322W2 filter, which is roughly the limit for an extractable positional information based on the May 2024 YR4 dataset. While not preferred, this would allow the F322W2 filter to be used as a contingency if there were a problem with the shorter-wavelength data.

There are only two windows during YR4's observability windows that give sufficient Gaia stars close enough to YR4 in the FOV of the short-wavelength side of NIRCam for at least five hours. We request time in both windows to provide two positions, further improving the orbit solution. We propose use of the SHALLOW2 readout pattern, which avoids data excess issues. The two windows appear to be, unavoidably, in the MAZ.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	2024YR4	TYPE=ASTEROID,A=2.516308070047454,E=0.6615999301423001,I=3.408259321981154,O=271.3674693540159,W=134.3644983455991,M=16.93290662173731,EQUINOX=J2000,EPOCH=30-JAN-2025:00:00:00,EpochTimeScale=TDB		

Comments: Extended=Unknown

Observation

Proposal 9441, Observation 1

Wed Jul 23 22:00:20 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

(Observation 1) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

(Visit 1:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	2024YR4	TYPE=ASTEROID,A=2.516308070047454,E=0.6615999301423001,I=3.408259321981154,O=271.3674693540159,W=134.3644983455991,M=16.93290662173731,EQUINOX=J2000,EPOCH=30-JAN-2025:00:00:00,EpochTimeScale=TDB		

Comments: Extended=Unknown

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	F150W2	F322W2	SHALLOW2	10	9	36	4	18510.191	

Special Requirements

Between Dates 18-FEB-2026:05:45:00 and 18-FEB-2026:21:45:00
Offset 40.0 arcsec, 40.0 arcsec

DEFAULT WINDOW: ANGULAR RATE 2024YR4 FROM JWST LESS THAN 0.075

Observation

Proposal 9441, Observation 2

Wed Jul 23 22:00:20 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

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

(Visit 2:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	2024YR4	TYPE=ASTEROID,A=2.516308070047454,E=0.6615999301423001,I=3.408259321981154,O=271.3674693540159,W=134.3644983455991,M=16.93290662173731,EQUINOX=J2000,EPOCH=30-JAN-2025:00:00:00,EpochTimeScale=TDB		

Comments: Extended=Unknown

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	F150W2	F322W2	SHALLOW2	10	9	36	4	18510.191	

Special Requirements

Between Dates 26-FEB-2026:16:30:00 and 26-FEB-2026:22:30:00
Offset 40.0 arcsec, 40.0 arcsec

DEFAULT WINDOW: ANGULAR RATE 2024YR4 FROM JWST LESS THAN 0.075