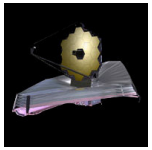

# 2134 - Absolute Brightness Measuremt of the Extragalactic Background Light Using Gallilean Satellites Eclipse Occultations

Cycle: 1, Proposal Category: GO

**INVESTIGATORS**



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**OBSERVATIONS**

| *Folder* | *Observation* | *Label* | *Observing Template* | *Science Target* |
|---|---|---|---|---|
| Europa eclipse | | | | |
| | 1 | Europa eclipse | NIRCam Imaging | (1) EUROPA-OFFSET |
| | 2 | Europa eclipse | NIRCam Imaging | (2) EUROPA-OFFSET2 |
| Ganymede Eclipse | | | | |
| | 3 | Ganymede eclipse | NIRCam Imaging | (5) GANYMEDE-OFFSET-V3 |
| | 4 | Ganymede eclipse | NIRCam Imaging | (6) GANYMEDE-OFFSET-V4 |

**ABSTRACT**

The Extragalactic Background Light (EBL) as an integrated history of the early universe is important for the study of unresolved star formation. However, previous EBL measurements suffer from residual contamination from strong foregrounds, the zodiacal light (ZL). We propose to observe Galilean satellites eclipsed in the Jovian shadow as occulters to detect the absolute EBL intensity without any ZL uncertainty. ZL originates inside

the Jovian orbit; since the Galilean satellites in eclipse shield all light beyond the Jovian orbit, they should be detected as 'dark spots' if the strong EBL implied by previous observations exists. The intensity deficit of this dark spot relative to the surrounding sky directly measures the brightness of EBL, free from any assumptions about ZL. The observationl condition for EBL is perfect at JWST Cycle-1 season because Jupiter locates at high Galactic latitude (|b| > 40 deg) and deep eclipses will occure, which is the opportunity once in 6 years. Therefore, observations in this Cycle-1 are highly required.

**OBSERVING DESCRIPTION**

Our observational targets are the Galilean satellites (Europa, Ganymede and Callisto), which are non-stationary targets. Since our method relies on specific astronomical events, chances for observation are limited and timing is absolutely critical; in particular, observations must begin at the specified time. The basic information of eclipse (time and position of Jupiter andthe Galillean satellites) are provided by the Natural Satellites Ephemeride Server MULTISAT (http://www.sai.msu.ru/neb/nss/nssphe0he.htm) and the JPL-HORIZONS System (http://ssd.jpl.nasa.gov/horizons.cgi). For example, in a Ganymede eclipse case on Jun. 2nd, 2022, the diameter of Ganymede is 1.30 arcsec circle, it is located at 4-39 arcsec from Jovian limb, and its relative speed to the Jupiter is 2.6 mas/sec.

Our strategy is to measure the EBL brightness as a dark spot, and the zodiacal light brightness can be evaluated locally around the dark spot itself. The estimated EBL brightness is 10 nW/m2/sr at 1.4 μm, which can be detected by NIRcam imaging with F140M filter by 1 hour integration with S/N=10. The greatest difficulty in this observation results from scattered light due to the close proximity of Jupiter to the target satellites, which will reduce S/N. However, Jupiter is dark at F140M owing to the methane absorption in the Jovian atmosphere, thus stray light from Jupiter is also reduced. In addition, we will keep Jupiter out of the detector field of view (FoV) during the observation to avoid stray light from Jupiter. Observations will be conducted with non-sidereal tracking on Jupiter (outside of the FoV) to fix the stray light pattern on the detector during the observation. This will minimize the systematic error of the Jovian stray light. Since the relative speed of the target satellites to Jupiter is ~2.6 mas/sec, short integrations (10 sec) are required to avoid smearing of the target satellite. Letting the eclipsed satellite move relative to the detector using Jupiter tracking has the advantage of effectively dithering the observations so that we can average out any detector issues. We emphasize that we know the ephemeri of Galilean satellites with great precision; the size and location of the Galilean satellites will be accurately known, and therefore easily differentiated from detector effects. In addition, simultaneous observations at F445W trace the position of the satellite in eclipse because thermal emission from 120 K surface of the satelite at >4 μm is detectable even in eclipse.

**Solar System Targets**

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (1) | EUROPA-OFFSET | STD=JUPITER | TYPE=POS_ANGLE,RAD=102.5,ANG=62,REF=NORTH | |
| *Comments: Extended=YES* | | | | |
| (2) | EUROPA-OFFSET2 | STD=JUPITER | TYPE=POS_ANGLE,RAD=100,ANG=250,REF=NORTH | |
| *Comments: Extended=YES* | | | | |
| (5) | GANYMEDE-OFFSET-V3 | STD=JUPITER | TYPE=POS_ANGLE,RAD=90,ANG=234,REF=NORTH | |
| *Comments: Target for Obs 3. Extended=Unknown* | | | | |
| (6) | GANYMEDE-OFFSET-V4 | STD=JUPITER | TYPE=POS_ANGLE,RAD=105,ANG=258,REF=NORTH | |
| *Comments: Target for Observation 4 Extended=Unknown* | | | | |

## Observation

**Proposal 2134, Observation 1: Europa eclipse** Mon Mar 02 17:00:16 GMT 2026

**Diagnostic Status: Warning**

Observing Template: NIRCam Imaging

## Diagnostics

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

(Visit 1:1) Warning (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.

(Europa eclipse (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) | EUROPA-OFFSET | STD=JUPITER | TYPE=POS_ANGLE,RAD=102.5,ANG=62,REF=NORTH | |

*Comments: Extended=YES*

## Template

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

## Dithers

| # | Primary Dither Type | Primary Dithers | Subpixel Dither Type | Dither Size | Subpixel Positions |
|---|---|---|---|---|---|
| 1 | NONE | | STANDARD | | 2 |

## Spectral Elements

| # | Short Filter | Long Filter | Readout Pattern | Groups/Int | Integrations/Exp | Total Integrations | Total Dithers | Total Exposure Time | Optional ETC ID |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F140M | F356W | SHALLOW4 | 5 | 2 | 4 | 2 | 1052.203 | |
| 2 | F140M | F356W | SHALLOW4 | 5 | 2 | 4 | 2 | 1052.203 | |
| 3 | F140M | F356W | SHALLOW4 | 5 | 2 | 4 | 2 | 1052.203 | |
| 4 | F140M | F356W | SHALLOW4 | 5 | 2 | 4 | 2 | 1052.203 | |

## Special Requirements

ECLIPSE UMBRAL FULL OF EUROPA BY JUPITER FROM JWST
DEFAULT WINDOW: NOT OCCULTATION OF EUROPA-OFFSET BY JUPITER FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF EUROPA-OFFSET BY IO FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF EUROPA-OFFSET BY EUROPA FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF EUROPA-OFFSET BY GANYMEDE FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF EUROPA-OFFSET BY CALLISTO FROM JWST
DEFAULT WINDOW: SEPARATION OF EUROPA-OFFSET IO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF EUROPA-OFFSET GANYMEDE FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF EUROPA-OFFSET CALLISTO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: ANGULAR RATE EUROPA-OFFSET FROM JWST LESS THAN 0.03
SEPARATION OF JUPITER EUROPA FROM JWST GREATER THAN 4"

## Observation

**Proposal 2134, Observation 2: Europa eclipse**

Mon Mar 02 17:00:16 GMT 2026

**Diagnostic Status: Warning**

Observing Template: NIRCam Imaging

## Diagnostics

(Europa eclipse (Obs 2)) Warning (Form): No dither offsets specified for observation

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

(Europa eclipse (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) | EUROPA-OFFSET2 | STD=JUPITER | TYPE=POS_ANGLE,RAD=100,ANG=250,REF=NORTH | |

*Comments: Extended=YES*

## Template

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

## Dithers

| # | Primary Dither Type | Primary Dithers | Subpixel Dither Type | Dither Size | Subpixel Positions |
|---|---|---|---|---|---|
| 1 | NONE | | SMALL-GRID-DITHER | | 1 |

## Spectral Elements

| # | Short Filter | Long Filter | Readout Pattern | Groups/Int | Integrations/Exp | Total Integrations | Total Dithers | Total Exposure Time | Optional ETC ID |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 2 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 3 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 4 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |

## Special Requirements

Between Dates 10-NOV-2025:12:30:00 and 10-NOV-2025:14:30:00

ECLIPSE UMBRAL FULL OF EUROPA BY JUPITER FROM JWST
DEFAULT WINDOW: NOT OCCULTATION OF EUROPA-OFFSET2 BY JUPITER FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF EUROPA-OFFSET2 BY IO FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF EUROPA-OFFSET2 BY EUROPA FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF EUROPA-OFFSET2 BY GANYMEDE FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF EUROPA-OFFSET2 BY CALLISTO FROM JWST
DEFAULT WINDOW: SEPARATION OF EUROPA-OFFSET2 IO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF EUROPA-OFFSET2 EUROPA FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF EUROPA-OFFSET2 GANYMEDE FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF EUROPA-OFFSET2 CALLISTO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: ANGULAR RATE EUROPA-OFFSET2 FROM JWST LESS THAN 0.075
SEPARATION OF EUROPA JUPITER FROM JWST GREATER THAN 5"

## Observation

**Proposal 2134, Observation 3: Ganymede eclipse**

Mon Mar 02 17:00:16 GMT 2026

**Diagnostic Status: Warning**

Observing Template: NIRCam Imaging

## Diagnostics

(Ganymede eclipse (Obs 3)) Warning (Form): No dither offsets specified for observation

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Ganymede eclipse (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (5) | GANYMEDE-OFFSET-V3 | STD=JUPITER | TYPE=POS_ANGLE,RAD=90,ANG=234,REF=NORTH | |

*Comments: Target for Obs 3.*
*Extended=Unknown*

## Template

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

## Dithers

| # | Primary Dither Type | Primary Dithers | Subpixel Dither Type | Dither Size | Subpixel Positions |
|---|---|---|---|---|---|
| 1 | NONE | | SMALL-GRID-DITHER | | 1 |

## Spectral Elements

| # | Short Filter | Long Filter | Readout Pattern | Groups/Int | Integrations/Exp | Total Integrations | Total Dithers | Total Exposure Time | Optional ETC ID |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 2 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 3 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 4 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 5 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 6 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |

## Special Requirements

Aperture PA Range 242.05262691 to 242.05262691 Degrees (V3 242.0 to 242.0)

ECLIPSE UMBRAL FULL OF GANYMEDE BY JUPITER FROM JWST
DEFAULT WINDOW: NOT OCCULTATION OF GANYMEDE-OFFSET-V3 BY JUPITER FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF GANYMEDE-OFFSET-V3 BY IO FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF GANYMEDE-OFFSET-V3 BY EUROPA FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF GANYMEDE-OFFSET-V3 BY GANYMEDE FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF GANYMEDE-OFFSET-V3 BY CALLISTO FROM JWST
DEFAULT WINDOW: SEPARATION OF GANYMEDE-OFFSET-V3 IO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF GANYMEDE-OFFSET-V3 EUROPA FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF GANYMEDE-OFFSET-V3 GANYMEDE FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF GANYMEDE-OFFSET-V3 CALLISTO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: ANGULAR RATE GANYMEDE-OFFSET-V3 FROM JWST LESS THAN 0.03

## Observation

**Proposal 2134, Observation 4: Ganymede eclipse** Mon Mar 02 17:00:16 GMT 2026

**Diagnostic Status: Warning**

Observing Template: NIRCam Imaging

## Diagnostics

(Ganymede eclipse (Obs 4)) Warning (Form): No dither offsets specified for observation

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

(Visit 4:1) Warning (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.

(Ganymede eclipse (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

## Solar System Targets

| # | Name | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| (6) | GANYMEDE-OFFSET-V4 | STD=JUPITER | TYPE=POS_ANGLE,RAD=105,ANG=258,REF=NORTH | |

*Comments: Target for Observation 4*
*Extended=Unknown*

## Template

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

## Dithers

| # | Primary Dither Type | Primary Dithers | Subpixel Dither Type | Dither Size | Subpixel Positions |
|---|---|---|---|---|---|
| 1 | NONE | | SMALL-GRID-DITHER | | 1 |

## Spectral Elements

| # | Short Filter | Long Filter | Readout Pattern | Groups/Int | Integrations/Exp | Total Integrations | Total Dithers | Total Exposure Time | Optional ETC ID |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 2 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 3 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 4 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 5 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |
| 6 | F140M | F356W | SHALLOW4 | 5 | 4 | 4 | 1 | 1062.94 | |

## Special Requirements

Aperture PA Range 285.05262691 to 285.05262691 Degrees (V3 285.0 to 285.0)

ECLIPSE UMBRAL FULL OF GANYMEDE BY JUPITER FROM JWST
DEFAULT WINDOW: NOT OCCULTATION OF GANYMEDE-OFFSET-V4 BY JUPITER FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF GANYMEDE-OFFSET-V4 BY IO FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF GANYMEDE-OFFSET-V4 BY EUROPA FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF GANYMEDE-OFFSET-V4 BY GANYMEDE FROM JWST
DEFAULT WINDOW: NOT ECLIPSE PENUMBRAL PARTIAL OF GANYMEDE-OFFSET-V4 BY CALLISTO FROM JWST
DEFAULT WINDOW: SEPARATION OF GANYMEDE-OFFSET-V4 IO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF GANYMEDE-OFFSET-V4 EUROPA FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF GANYMEDE-OFFSET-V4 GANYMEDE FROM JWST GREATER THAN 10"
DEFAULT WINDOW: SEPARATION OF GANYMEDE-OFFSET-V4 CALLISTO FROM JWST GREATER THAN 10"
DEFAULT WINDOW: ANGULAR RATE GANYMEDE-OFFSET-V4 FROM JWST LESS THAN 0.03