18048 - Identifying Auroral Currents at Jupiter

Cycle: 33, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) JUPITER-NORTH-SPEC-1 WAVE	STIS/FUV-MAMA	2	10-Feb-2026 09:00:15.0	yes
02	(2) JUPITER-NORTH-SPEC-2 WAVE	STIS/FUV-MAMA	2	10-Feb-2026 09:00:16.0	yes
03	(3) JUPITER-NORTH-SPEC-3 WAVE	STIS/FUV-MAMA	2	10-Feb-2026 09:00:17.0	yes

6 Total Orbits Used

ABSTRACT

Prior to the arrival of JUNO at Jupiter, the acceleration of high energy charged particles producing the bright aurora was thought to be well understood. During its close passes, however, the expected magnetic field-aligned potential structures accelerating the electrons into Jupiter's atmosphere have not been found, even when flying through magnetic flux tubes of bright aurora. Things are more complicated than thought, and other processes have to involve the acceleration of ions and electrons below JUNO's altitude in the form of ionospheric currents in auroral regions. Ionospheric current systems strongly heat the neutral atmosphere, and HST can measure the H2 temperature at the emission altitudes by resolving H2 ro-vibrational emissions. High temperatures indicate Joule heating from electric currents, which are carried by ions across magnetic field lines (in the case of Jupiter, mainly protons). The strong heating locations can be identified across the auroral oval using HST/STIS with G140M. In addition, proton-excited auroral emissions can be identified through Doppler-shifted H Lyman-alpha emissions from charge exchange of fast protons with atmospheric neutrals. This is an emission signature that HST can measure, however there are only two prior observations with the spectral resolution and sensitivity to detect it. This proposal is to perform scans across Jupiter's northern auroral region to identify regions of ionospheric heating/currents and proton-excited aurora. The observations will be scheduled close in time to JUNO perijove passes, which will record the charged particle environment in Jupiter's auroral regions.

OBSERVING DESCRIPTION

The observations will use the STIS G140M grating with the 52 x 0.5 arc sec aperture positioned across the northern auroral zone on Jupiter. The nominal roll angles in the past have been good for these observations, since Jupiter is always near the ecliptic plane, and no added constraints are needed. In cycle 33 Jupiter is observable in reduced gyro mode (RGM) from 1 Nov. to mid-Dec. 2026 and again at the end of the cycle. Another criterion is to have a line of sight Doppler shift (mainly from the Earth orbital motion) greater than 10 km/sec to prevent geocoronal H atoms from scattering the line center photons from Jupiter. The observations will be scheduled as close in time as is practical to Juno perijove (PJ) passes for comparison of the Juno charged particle data with the HST spectra. During cycle 33 with HST in RGM the possible passes are PJ 78 (19 Nov. 2025), PJ 79 (21 Dec. 2025), and PJ 88 (11 Oct. 2026).

The counting rates with G140M spectra and STIS FUV imaging of Jupiter are well below the upper limits for the MAMA detectors. From past observations the count rate for G140M is 1.6 counts/sec-kiloRayleigh from a 1 arc sec area. Jupiter's aurora are a few hundred kiloRayleighs (kR) in brightness, and the resolution is .025 arc sec (about 100 km at Jupiter). We will coadd rows to increase the sensitivity, i.e. a 0.5 arc sec area along the aperture (2000 km at Jupiter) will give 480 counts/kR with the counts divided into H2 bands and H line emission. Counting ~ 25 bands in the spectrum in Fig. 1, this gives 200 counts/band for a 10 kR emission for a sensitivity limit. After years of FUV observations of Jupiter with HST / STIS the methods for bright object protection are well established. The auroral emission region will be placed in the lower half of the UV-MAMA

detector active area to avoid the area of highest dark counts in the upper left quadrant.

The STIS G140M grating spectral resolution of 0.97 A (for diffuse emission filling the 0.5 arc sec aperture) resolves the H2 bands and allows for continuum detection (Fig. 2). Compared with model profiles (Fig. 1) this can also detect Doppler shifted Lyman-a emission down to ~ 100 eV energy for fast protons. In a 600 sec. integration time, the count rate of 200 counts/band for a 10 kR emission is sufficient to provide an accurate temperature measurement. It also provides a sensitive search for proton-excited emissions down to the level of a kilo-Rayleigh.

Each visit will consist of two orbits, and each orbit will have the G140M time-tagged spectral scan followed by a short (100 sec) STIS MAMA F25SRF2 image to establish the auroral brightness distribution. The rest of the time will be spent with G140M slowly scanned across the auroral emission region. The complete auroral oval is about 10 arc sec across, and the data can be divided into time steps depending in part on the angle of the aperture on the planet. To the extent that the aperture is aligned E/W on Jupiter, more of the emission region will fall in the aperture at each step, and longer segments can be used. We will determine the exact pattern of the scan once the date and angle of the aperture from the nominal HST roll angle are known. Assuming ~ 5 aperture positions in a given orbit, we will get 500 sec. per observation step. Assigning two HST orbits to each visit will greatly improve the sensitivity to the known highly variable auroral emissions.

Visit

Proposal 18048, Visit 01, completed Tue Feb 10 14:00:17 GMT 2026

Diagnostic Status: Warning

Scientific Instruments: STIS/FUV-MAMA

Special Requirements: BETWEEN 18-NOV-2025:08:00:00 AND 18-NOV-2025:09:00:00

Comments: BETWEEN range is set for 3 days closest to JUNO orbital pass by Jupiter. This includes 7 Jupiter CML windows. Window can be expanded if needed to schedule.

No target acquisition is needed for extended target - we derive pointing from image of Jupiter.

ETC not used for highly variable auroral brightness - modes and exp. times based on prior observations and not close to STIS count rate limit.

Diagnostics

(Visit 01) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronography with STIS or COS.

(Exposure 1 (Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 2 (Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 4 (Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 5 (Visit 01)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Visit 01) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

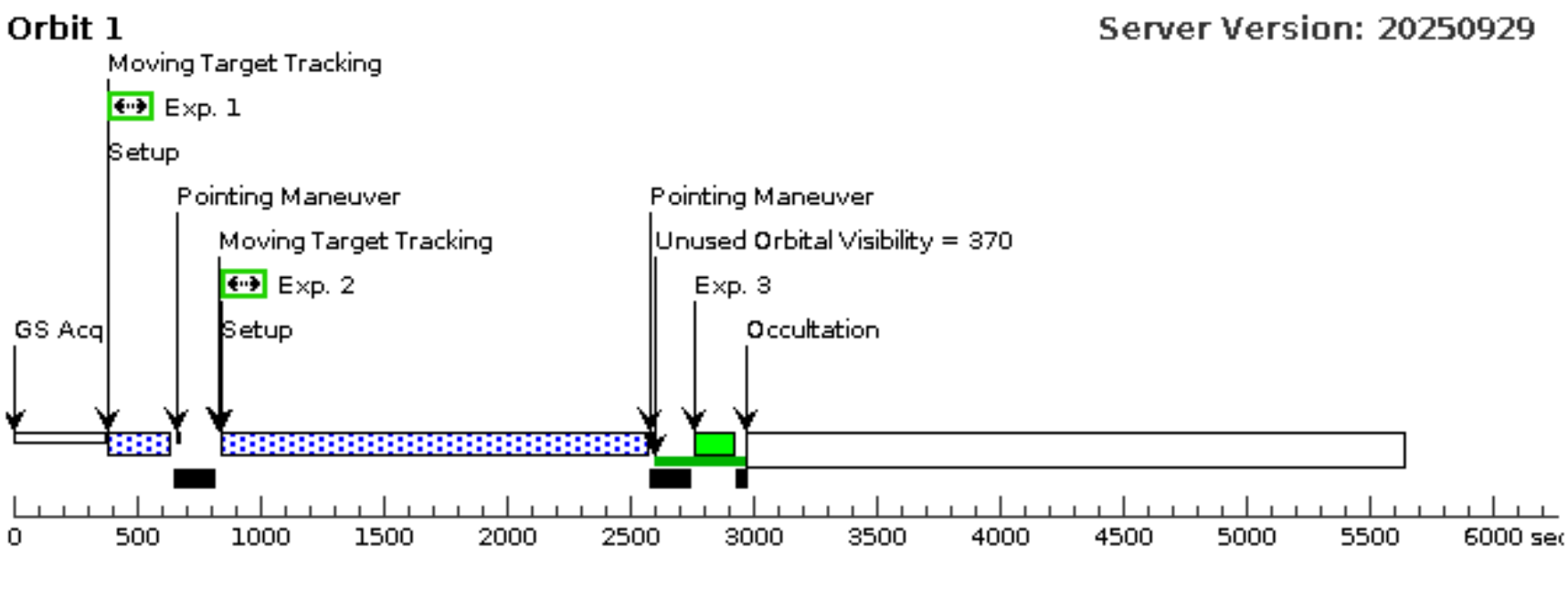
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	JUPITER-NORTH-SPEC-1	STD=JUPITER	TYPE=POS_ANGLE,RAD=20,ANG=0,REF=NORTH,R_RAD=-60,R_ANG=90,EPOCH=18-NOV-2025:08:42:00,EpochTimeScale=UTC		NOT OCC OF JUPITER-NORTH-SPEC-1 BY JUPITER FROM EARTH, CML OF JUPITER FROM EARTH BETWEEN 140 260	EARTH

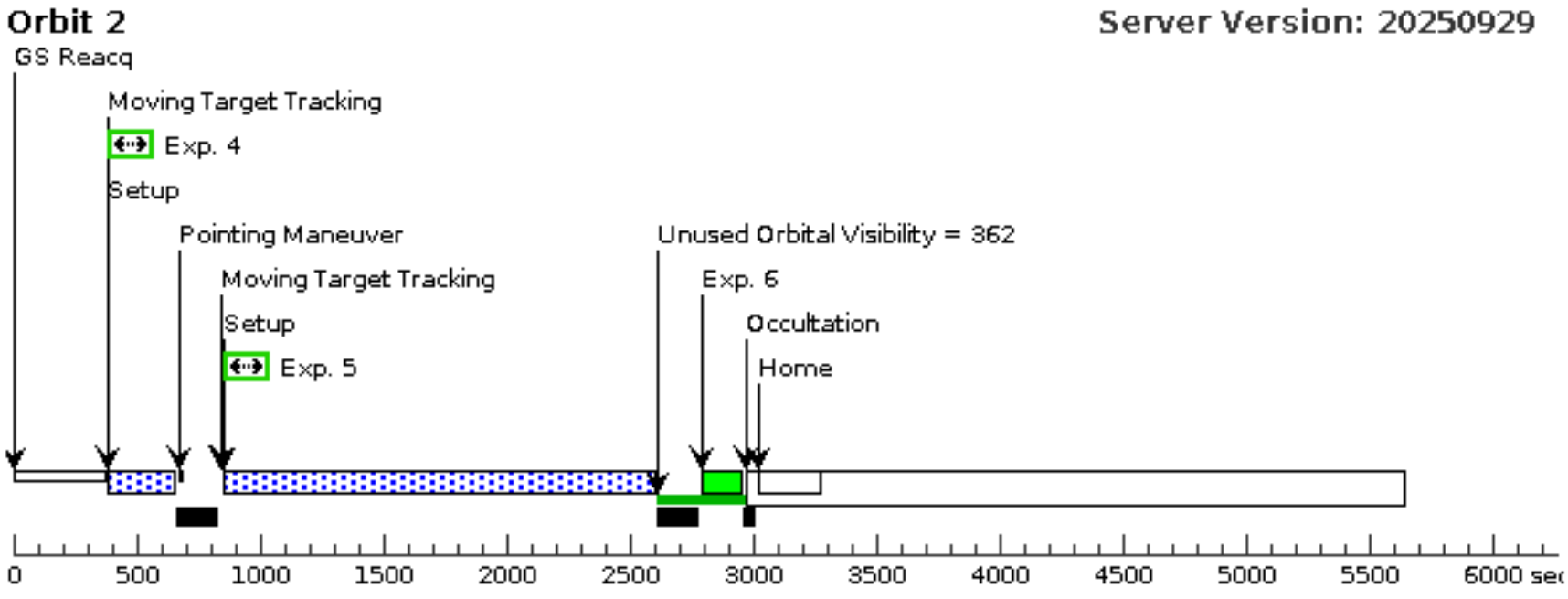
Comments: Numbers for POS_ANGLE offset and scan rate have been updated for the time of observation.
Description=Planet Jupiter North Aurora
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) JUPITER-NORTH-SPEC-1	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99			100 Secs (100 Secs) *[==>]*	***[1]***
2		(1) JUPITER-NORTH-SPEC-1	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO			1550 Secs (1550 Secs) *[==>]*	***[1]***
3		WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A				*[==>]*	***[1]***
4		(1) JUPITER-NORTH-SPEC-1	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99; WAVECAL=NO			100 Secs (100 Secs) *[==>]*	***[2]***
5		(1) JUPITER-NORTH-SPEC-1	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140M 1222 A	BUFFER-TIME=1000			1570 Secs (1570 Secs) *[==>]*	***[2]***
6		WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A				*[==>]*	***[2]***

Orbit Structure





Proposal 18048 - Visit 02 - Identifying Auroral Currents at Jupiter

Visit

Proposal 18048, Visit 02, completed Tue Feb 10 14:00:17 GMT 2026

Diagnostic Status: Warning

Scientific Instruments: STIS/FUV-MAMA

Special Requirements: BETWEEN 19-DEC-2025:18:55:00 AND 19-DEC-2025:20:00:00

Comments: BETWEEN range is set for 3 days closest to JUNO orbital pass by Jupiter. This includes 7 Jupiter CML windows. Window can be expanded if needed to schedule.

No target acquisition is needed for extended target - we derive pointing from image of Jupiter.

ETC not used for highly variable auroral brightness - modes and exp. times based on prior observations and not close to STIS count rate limit.

Diagnostics

(Visit 02) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronography with STIS or COS.

(Exposure 1 (Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 2 (Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 4 (Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 5 (Visit 02)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Visit 02) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

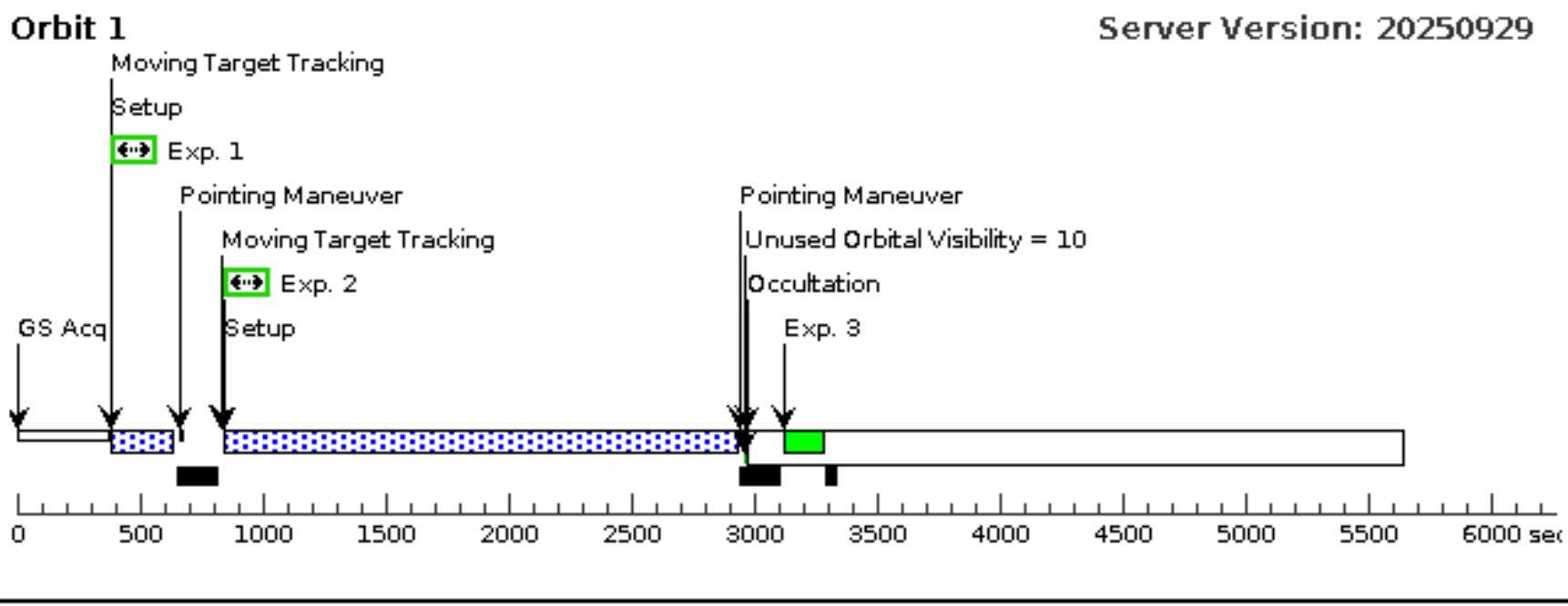
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	JUPITER-NORTH-SPEC-2	STD=JUPITER	TYPE=POS_ANGLE,RAD=20,ANG=0,REF=NORTH,R_RAD=-30,R_ANG=45,EPOCH=19-DEC-2025:19:32:00,EpochTimeScale=UTC		NOT OCC OF JUPITER-NORTH-SPEC-2 BY JUPITER FROM EARTH, CML OF JUPITER FROM EARTH BETWEEN 140 260	EARTH

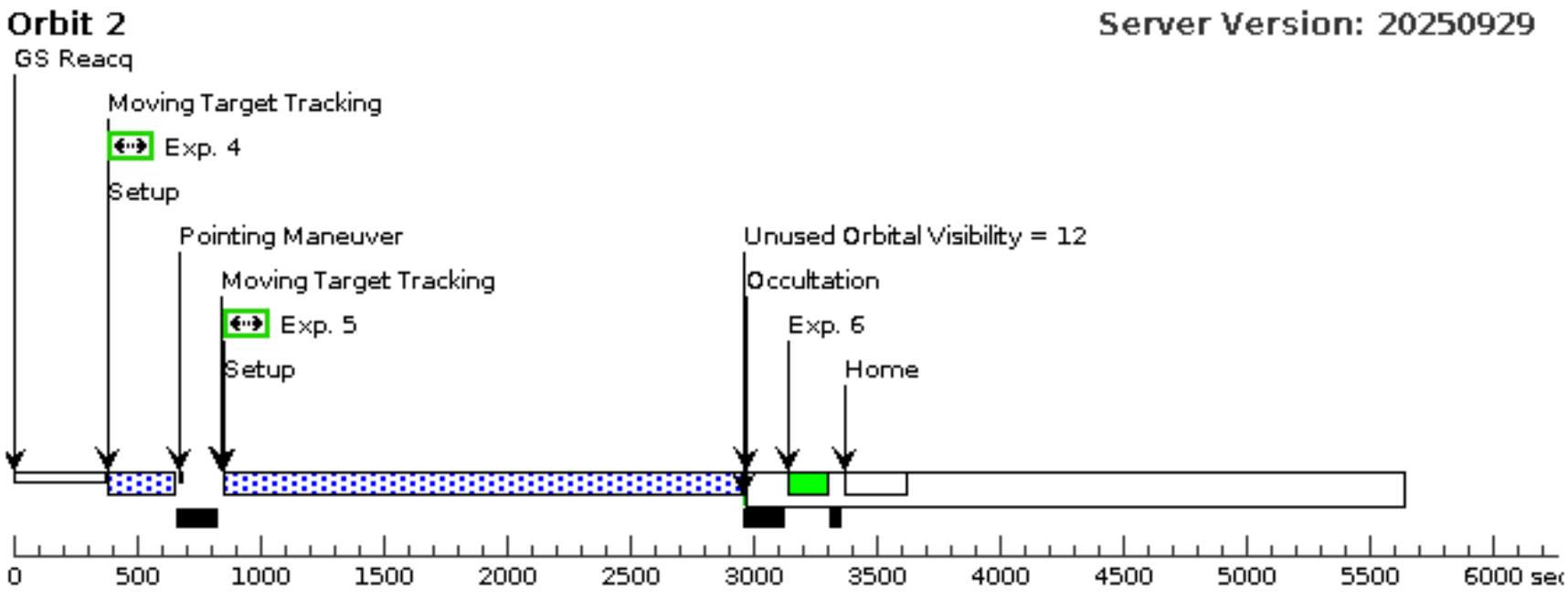
Comments: Numbers for POS_ANGLE offset and scan rate are placeholders - actual values will depend on when visit is scheduled and can be updated then.
Description=Planet Jupiter North Aurora
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) JUPITER-NORTH-SPEC-2	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99			100 Secs (100 Secs) *[==>]*	***[1]***
2		(2) JUPITER-NORTH-SPEC-2	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140M 1222 A	BUFFER-TIME=1000			1910 Secs (1910 Secs) *[==>]*	***[1]***
3		WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A				*[==>]*	***[1]***
4		(2) JUPITER-NORTH-SPEC-2	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99			100 Secs (100 Secs) *[==>]*	***[2]***
5		(2) JUPITER-NORTH-SPEC-2	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO			1920 Secs (1920 Secs) *[==>]*	***[2]***
6		WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A				*[==>]*	***[2]***

Orbit Structure





Visit

Proposal 18048, Visit 03, implementation Tue Feb 10 14:00:17 GMT 2026

Diagnostic Status: Warning

Scientific Instruments: STIS/FUV-MAMA

Special Requirements: BETWEEN 10-DEC-2026:00:00:00 AND 13-DEC-2026:00:00:00

Comments: BETWEEN range is set for 3 days closest to JUNO orbital pass by Jupiter. This includes 7 Jupiter CML windows. Window can be expanded if needed to schedule.

No target acquisition is needed for extended target - we derive pointing from image of Jupiter.

ETC not used for highly variable auroral brightness - modes and exp. times based on prior observations and not close to STIS count rate limit.

Diagnostics

(Visit 03) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronography with STIS or COS.

(Exposure 1 (Visit 03)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 2 (Visit 03)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 4 (Visit 03)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 5 (Visit 03)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Visit 03) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	JUPITER-NORTH-SPEC-3	STD=JUPITER	TYPE=POS_ANGLE,RAD=20,ANG=0,REF=NORTH,R_RAD=-60,R_ANG=90,EPOCH=11-DEC-2026:00:00:00,EpochTimeScale=UTC		NOT OCC OF JUPITER-NORTH-SPEC-3 BY JUPITER FROM EARTH, CML OF JUPITER FROM EARTH BETWEEN 140 260	EARTH

Comments: Numbers for POS_ANGLE offset and scan rate are placeholders - actual values will depend on when visit is scheduled and can be updated then.
Description=Planet Jupiter North Aurora
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) JUPITER-NORTH-SPEC-3	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99			100 Secs (100 Secs) *[==>]*	***[1]***
2		(3) JUPITER-NORTH-SPEC-3	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO			1910 Secs (1910 Secs) *[==>]*	***[1]***
3		WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A				*[==>]*	***[1]***
4		(3) JUPITER-NORTH-SPEC-3	STIS/FUV-MAMA, TIME-TAG, F25SRF2	MIRROR	BUFFER-TIME=99			100 Secs (100 Secs) *[==>]*	***[2]***
5		(3) JUPITER-NORTH-SPEC-3	STIS/FUV-MAMA, TIME-TAG, 52X0.5	G140M 1222 A	BUFFER-TIME=1000; WAVECAL=NO			1920 Secs (1920 Secs) *[==>]*	***[2]***
6		WAVE	STIS/FUV-MAMA, ACCUM, 52X0.1	G140M 1222 A				*[==>]*	***[2]***

Orbit Structure