16074 - Cyclones as the Dominant Source Regions for Jovian Lightning

Cycle: 27, Proposal Category: GO

(UV Initiative)

(Availability Mode: AVAILABLE)

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?*
26	(1) JUPITER	WFC3/UVIS	1	24-Mar-2020 14:00:45.0	yes
27	(1) JUPITER	WFC3/UVIS	1	24-Mar-2020 14:00:46.0	yes
29	(1) JUPITER	WFC3/UVIS	1	24-Mar-2020 14:00:48.0	yes

3 Total Orbits Used

ABSTRACT

Lightning on Jupiter is associated with moist convection, spanning the water cloud level near 5 bar up to the tops of the ammonia clouds near 0.5 bar. Moist convection has been identified as a heat transport process able to transport most of Jupiter's internal heat to the cloud tops. The combination of Juno lightning measurements and HST photometric imaging for cloud structure will test the possibility that cyclonic vortices are the location of most

of the moist convective activity.

The Juno spacecraft has measured the spatial distribution of lightning flashes, showing that flash rates are highly variable with latitude, with a northern flash rate about 2x higher than in the south. This published result was based on data from the first third of the Juno mission (2016-2017), but a recent discovery announced in October 2019 suggests a shift in the latitudinal distribution in the second third of the mission (2017-2018).

We propose to cover Juno passes in April, June, and September 2020, using one HST orbit of WFC3 imaging for each pass. Along the spacecraft path, the HST observations will determine cloud structure proximity to cyclonic vortices at each latitude. Juno itself cannot provide the necessary context, because its visible-light camera lacks the filters to constrain cloud depth, and it has limited spatial coverage due to pointing constraints and data volume. By characterizing the fraction of lightning events closely associated with cyclonic vortices, we will be able to control for this factor in the search for actual temporal variation in the distribution of lightning with latitude.

OBSERVING DESCRIPTION

One orbit on each of three dates (see table). The objective is to time orbits so that the PJ longitude is close to disk center, and the observation time is close to the perijove time. After analyzing SAA timing and guide star placement, we have found that the best timing windows are one Jupiter rotation after the PJ26 pass, and one Jupiter rotation before the PJ27 and PJ29 passes.

Juno orbit number	Perijove (PJ) times (UTC)	PJ lon (deg)	Jup. dia. (arcsec)
26	2020-Apr-10 13:47	50.5	38.1
27	2020-Jun-02 10:19	342.9	44.8
29	2020-Sep-16 02:10	162.7	42.4

For each perijove, the optimized timing is encoded in BETWEEN timing requirements.

Filters in the APT file are ordered to maximize science return, assuming full visibility windows. For reduced visibility windows, frames are listed

here from high to low priority (although this list may be circumvented if particular problems are found due to guide star availability and multiple UVIS quandrants):

F395N
F631N
FQ727N (quad D)
F275W
FQ889N (quad A)
F225W
F502N
F275W
F225W
F343N

POS TARG [-15, +15] is used on all the 2K2D-SUB exposures to postion them closer to UVIS center and maintain guide stars.

We have approval for BLADE=A for 4-sec exposures (F631N and F502N) to minimize shutter-blade jitter.

Visit

Proposal 16074, Apr 10 - PJ 26 (26), implementation Tue Mar 24 18:00:48 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 10-APR-2020:23:42:33 AND 11-APR-2020:01:13:55

Diagnostics

(FQ889N_quadA (26.001)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(FQ889N_quadA (26.001)) Warning (Form): POS TARG & PATTERN should be used carefully with WFC3 quad filters to avoid placing the target on the vignetted part of the field of view or moving it to another quadrant.

(FQ727N_quadD (26.002)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

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(F275W (26.003)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F225W (26.004)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F631N (26.005)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F395N (26.006)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F502N (26.007)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F343N (26.008)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F225W (26.009)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F275W (26.010)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Solar System Targets

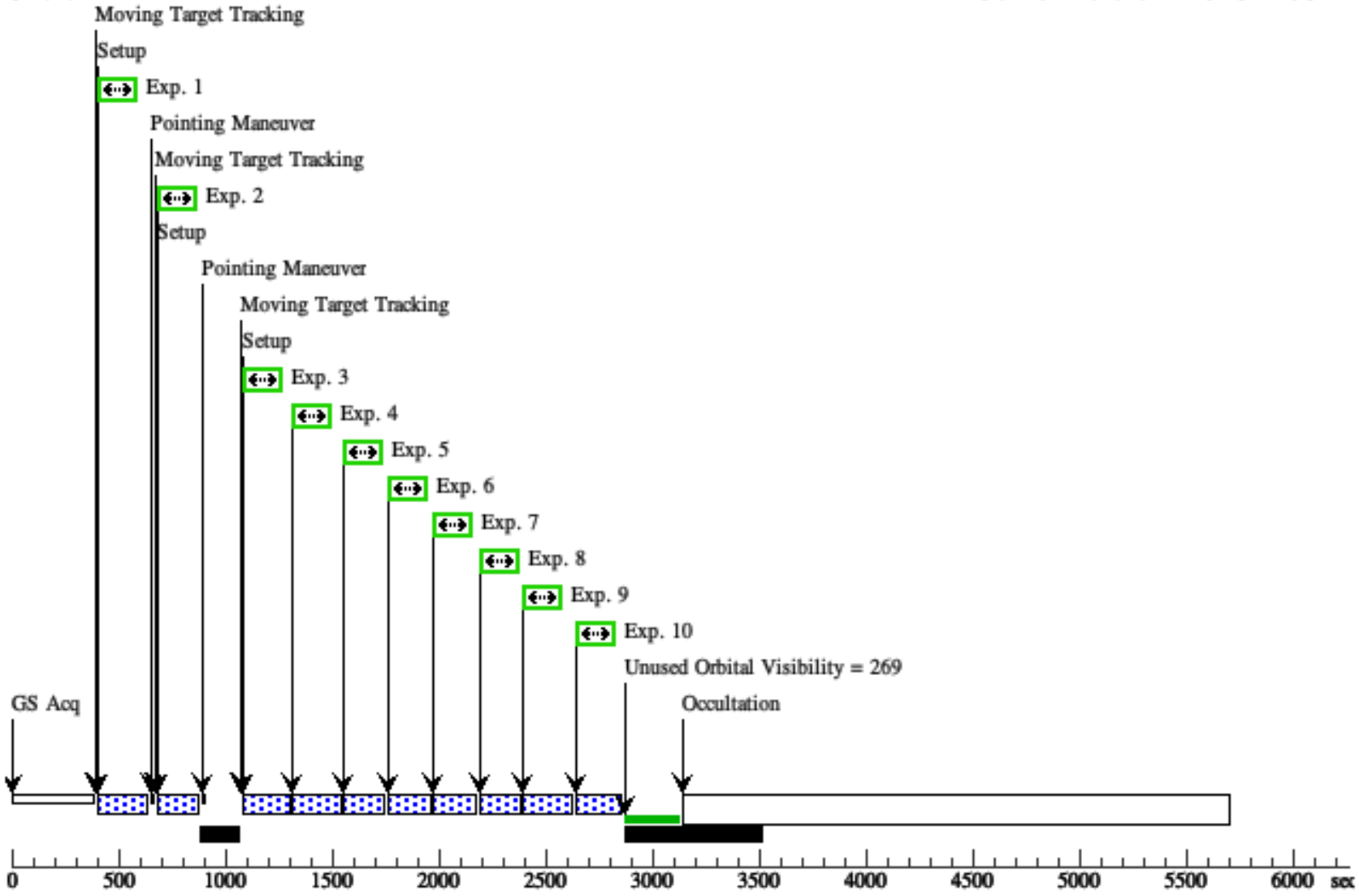
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	JUPITER	STD=JUPITER				EARTH

Comments: Description=Jupiter atmosphere
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	FQ889N_quadA	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N	CR-SPLIT=NO	POS TARG +5.94,-7.18	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	30 Secs (30 Secs) *[==>]*	 ***[1]***
2	FQ727N_quadD	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N	CR-SPLIT=NO	POS TARG -10.97,+11.96	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	8 Secs (8 Secs) *[==>]*	 ***[1]***
3	F275W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F275W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	20 Secs (20 Secs) *[==>]*	 ***[1]***
4	F225W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F225W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	40 Secs (40 Secs) *[==>]*	 ***[1]***
5	F631N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F631N	CR-SPLIT=NO; BLADE=A	POS TARG -15,+15	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	4 Secs (4 Secs) *[==>]*	 ***[1]***
6	F395N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F395N	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	9 Secs (9 Secs) *[==>]*	 ***[1]***
7	F502N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F502N	CR-SPLIT=NO; BLADE=A	POS TARG -15,+15	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	4 Secs (4 Secs) *[==>]*	 ***[1]***
8	F343N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F343N	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	6 Secs (6 Secs) *[==>]*	 ***[1]***
9	F225W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F225W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	40 Secs (40 Secs) *[==>]*	 ***[1]***
10	F275W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F275W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Apr 10 - PJ 26 (26)	20 Secs (20 Secs) *[==>]*	 ***[1]***

Orbit Structure



Visit

Proposal 16074, Jun 02 - PJ 27 (27), implementation Tue Mar 24 18:00:48 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 02-JUN-2020:00:18:43 AND 02-JUN-2020:01:49:45

Diagnostics

(FQ889N_quadA (27.001)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(FQ889N_quadA (27.001)) Warning (Form): POS TARG & PATTERN should be used carefully with WFC3 quad filters to avoid placing the target on the vignetted part of the field of view or moving it to another quadrant.

(FQ727N_quadD (27.002)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

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(F275W (27.003)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F225W (27.004)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F631N (27.005)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F395N (27.006)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F502N (27.007)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F343N (27.008)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F225W (27.009)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F275W (27.010)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Solar System Targets

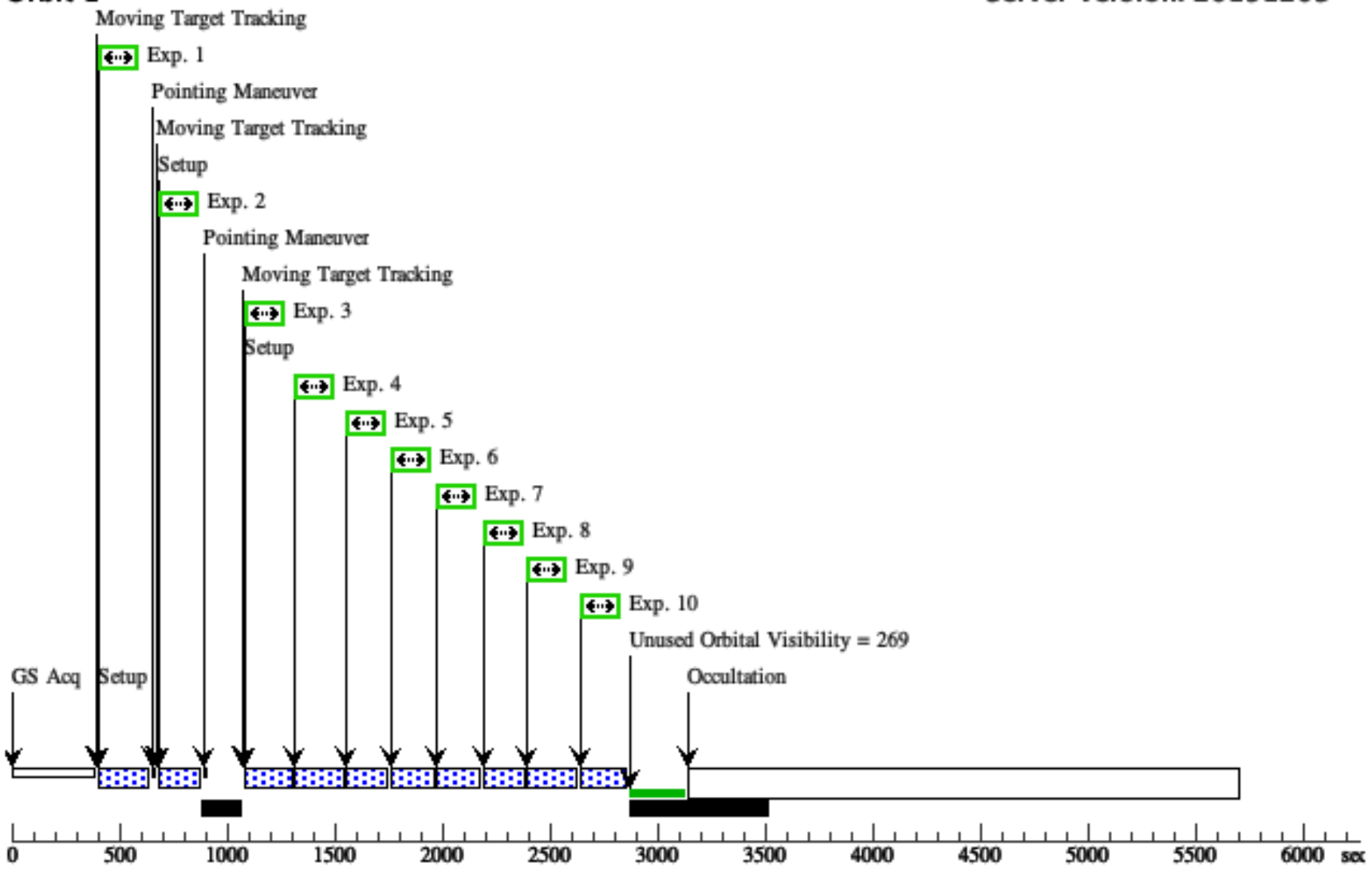
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	JUPITER	STD=JUPITER				EARTH

Comments: Description=Jupiter atmosphere
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	FQ889N_quadA	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N	CR-SPLIT=NO	POS TARG +2.93,-3.66	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	30 Secs (30 Secs) *[==>]*	 ***[1]***
2	FQ727N_quadD	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N	CR-SPLIT=NO	POS TARG -7.93,+8.39	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	8 Secs (8 Secs) *[==>]*	 ***[1]***
3	F275W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F275W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	20 Secs (20 Secs) *[==>]*	 ***[1]***
4	F225W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F225W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	40 Secs (40 Secs) *[==>]*	 ***[1]***
5	F631N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F631N	CR-SPLIT=NO; BLADE=A	POS TARG -15,+15	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	4 Secs (4 Secs) *[==>]*	 ***[1]***
6	F395N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F395N	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	9 Secs (9 Secs) *[==>]*	 ***[1]***
7	F502N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F502N	CR-SPLIT=NO; BLADE=A	POS TARG -15,+15	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	4 Secs (4 Secs) *[==>]*	 ***[1]***
8	F343N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F343N	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	6 Secs (6 Secs) *[==>]*	 ***[1]***
9	F225W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F225W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	40 Secs (40 Secs) *[==>]*	 ***[1]***
10	F275W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F275W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Jun 02 - PJ 27 (27)	20 Secs (20 Secs) *[==>]*	 ***[1]***

Orbit Structure



Visit

Proposal 16074, Sep 16 - PJ 29 (29), implementation Tue Mar 24 18:00:49 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 15-SEP-2020:16:20:00 AND 15-SEP-2020:17:45:00

Diagnostics

(FQ889N_quadA (29.001)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(FQ889N_quadA (29.001)) Warning (Form): POS TARG & PATTERN should be used carefully with WFC3 quad filters to avoid placing the target on the vignetted part of the field of view or moving it to another quadrant.

(FQ727N_quadD (29.002)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(FQ727N_quadD (29.002)) Warning (Form): POS TARG & PATTERN should be used carefully with WFC3 quad filters to avoid placing the target on the vignetted part of the field of view or moving it to another quadrant.

(F275W (29.003)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F225W (29.004)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F631N (29.005)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F395N (29.006)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F502N (29.007)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F343N (29.008)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F225W (29.009)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

(F275W (29.010)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	JUPITER	STD=JUPITER				EARTH

Comments: Description=Jupiter atmosphere
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	FQ889N_quadA	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ889N	CR-SPLIT=NO	POS TARG +4.01,-4.92	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	30 Secs (30 Secs)	
								[==>]	***[1]***
2	FQ727N_quadD	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ727N	CR-SPLIT=NO	POS TARG -9.02,+9.67	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	8 Secs (8 Secs)	
								[==>]	***[1]***
3	F275W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F275W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	20 Secs (20 Secs)	
								[==>]	***[1]***
4	F225W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F225W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	40 Secs (40 Secs)	
								[==>]	***[1]***
5	F631N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F631N	CR-SPLIT=NO; BLADE=A	POS TARG -15,+15	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	4 Secs (4 Secs)	
								[==>]	***[1]***
6	F395N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F395N	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	9 Secs (9 Secs)	
								[==>]	***[1]***
7	F502N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F502N	CR-SPLIT=NO; BLADE=A	POS TARG -15,+15	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	4 Secs (4 Secs)	
								[==>]	***[1]***
8	F343N	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F343N	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	6 Secs (6 Secs)	
								[==>]	***[1]***
9	F225W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F225W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	40 Secs (40 Secs)	
								[==>]	***[1]***
10	F275W	(1) JUPITER	WFC3/UVIS, ACCUM, UVIS2-2K2D-SUB	F275W	CR-SPLIT=NO	POS TARG -15,+15	Sequence 1-10 Non-Int in Sep 16 - PJ 29 (29)	20 Secs (20 Secs)	
								[==>]	***[1]***

Orbit Structure