16744 - A Mira Distance to M101: Towards a Sub-3% Hubble Constant with Miras and a NIR Candle for JWST and Roman

Cycle: 29, 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) SN-2011FE	WFC3/IR	1	30-Jul-2021 13:06:37.0	yes
02	(1) SN-2011FE	WFC3/IR	1	30-Jul-2021 13:06:38.0	yes
03	(1) SN-2011FE	WFC3/IR	1	30-Jul-2021 13:06:39.0	yes
04	(1) SN-2011FE	WFC3/IR	1	30-Jul-2021 13:06:40.0	yes
05	(1) SN-2011FE	WFC3/IR	1	30-Jul-2021 13:06:41.0	yes

5 Total Orbits Used

ABSTRACT

The discrepancy between local measurements of the Hubble constant (H0) and the value inferred from observations of the CMB may be our strongest indication of physics beyond a Lambda-CDM cosmological model. Direct, distance-ladder measurements of the H0 rely primarily on Cepheids and the Tip of the Red Giant Branch (TRGB) to calibrate the luminosity of Type Ia supernovae (SN Ia). Here we propose an independent approach using Mira variables. Miras can check existing Cepheid and TRGB measurements while extending the distance ladder in the era of infrared space missions such as JWST and Roman Space Telescope, which will have difficulty discovering Cepheids. Miras are pulsating variable stars that follow tight (~0.12 mag scatter) Period-Luminosity Relations (PLRs) in the near-infrared (NIR). Short-period Miras (P < 400 d) have NIR luminosities up to 2 mag brighter than TRGB and are a ubiquitous older population that have already been used to calibrate H0 with 5% uncertainty. Long-period Miras (P > 400 d) are highly luminous and follow a different PLR from short-period Miras. We will (1) obtain a new distance measurement to this galaxy using short-period Miras, resulting in a sub-3% calibration of H0 with Miras when combined with existing Mira-SN Ia hosts; (2) discover long-period Miras with HST for the first time; (3) cross-correlate long-period variables discovered in HST with Spitzer IR observations. To do this, we propose to obtain 5 epochs of near-infrared observation in M101, to study Miras in the field of SN Ia 2011fe. Combining these with archival observations of the late-time lightcurve of SN 2011fe results in ~10 epochs of observation with a baseline of ~3000 days.

OBSERVING DESCRIPTION

We will obtain time-series observations of the field surrounding SN 2011fe--located in M101--using WFC3/IR F160W and WFC3/IR F110W to search for Mira variables. These will supplement the previous time-series observations of this field that were used to study the late-time lightcurve of SN 2011fe obtained with the same filters to create a long baseline.

Visit

Proposal 16744, Visit 1 (01) Fri Jul 30 17:06:41 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: AFTER 01-OCT-2021:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1-2)

Fixed Targets

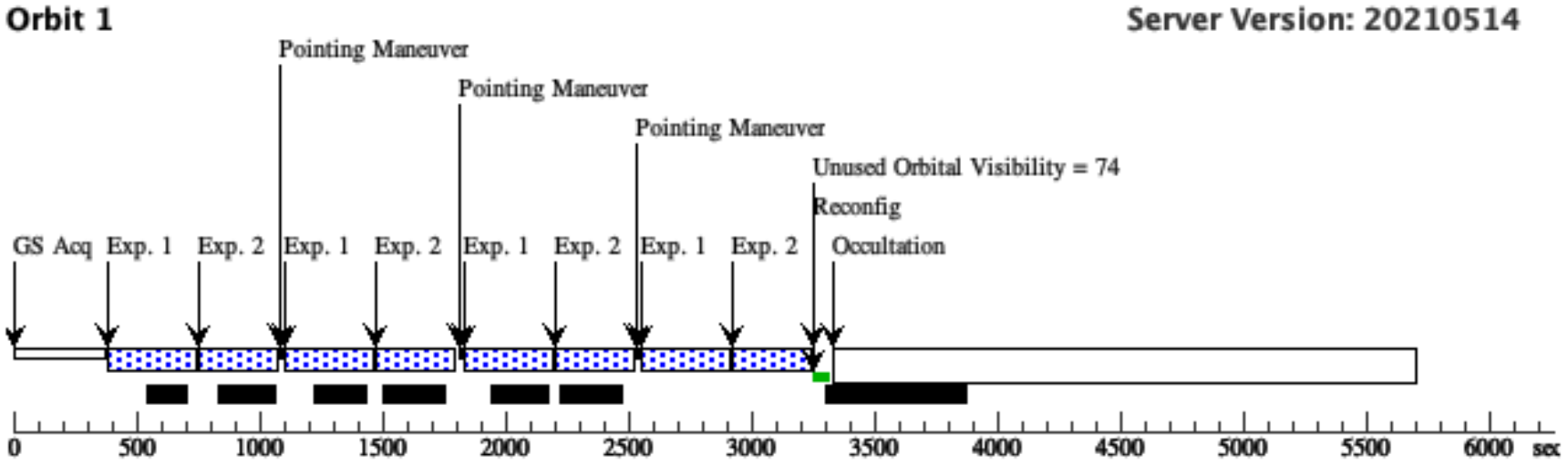
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2011FE	RA: 14 03 5.7110 (210.7737958d) Dec: +54 16 25.22 (54.27367d) Equinox: J2000	Epoch of Position: 2015.5	V=10.06	Reference Frame: SIMBAD

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[SPIRAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F160W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS25; NSAMP=14		Pattern 1, Exps 1-2 in Visit 1 (01) (1)	327.938986 Secs (1311.756 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	 ***[1]***
2	F110W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=7		Pattern 1, Exps 1-2 in Visit 1 (01) (1)	302.934997 Secs (1211.74 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	 ***[1]***

Orbit Structure



Visit

Proposal 16744, Visit 2 (02) Fri Jul 30 17:06:42 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: AFTER 01 BY 20 D TO 40 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1-2)

Fixed Targets

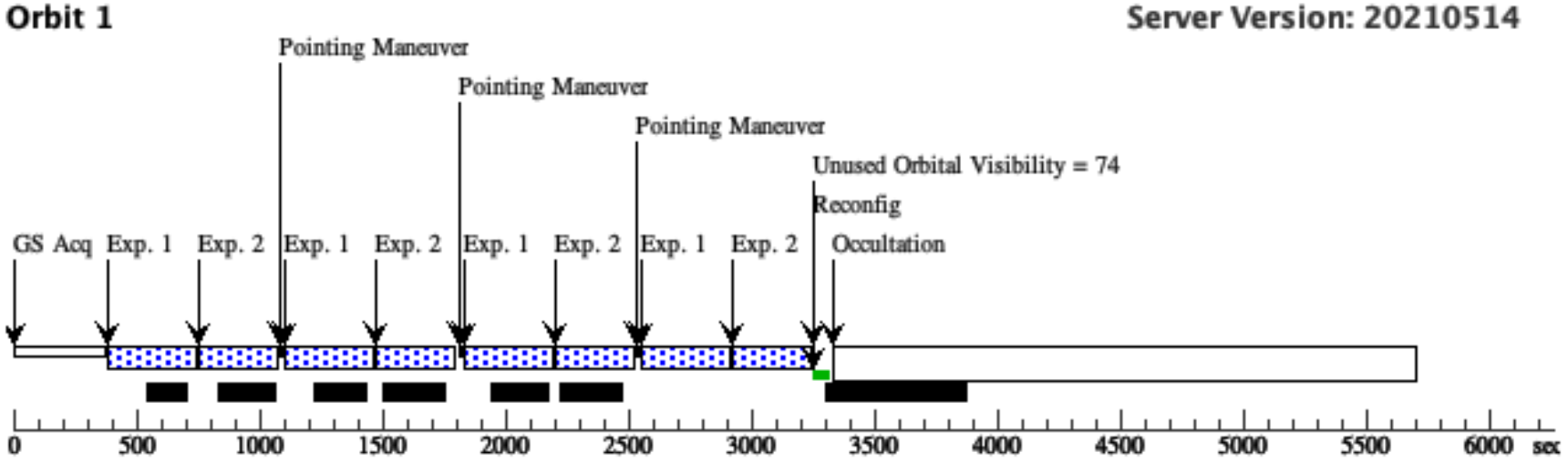
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2011FE	RA: 14 03 5.7110 (210.7737958d) Dec: +54 16 25.22 (54.27367d) Equinox: J2000	Epoch of Position: 2015.5	V=10.06	Reference Frame: SIMBAD

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[SPIRAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F160W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS25; NSAMP=14		Pattern 1, Exps 1-2 in Visit 2 (02) (1)	327.938986 Secs (1311.756 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	 ***[1]***
2	F110W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=7		Pattern 1, Exps 1-2 in Visit 2 (02) (1)	302.934997 Secs (1211.74 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	 ***[1]***

Orbit Structure



Visit

Proposal 16744, Visit 3 (03) Fri Jul 30 17:06:42 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: AFTER_02 BY 30 D TO 50 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1-2)

Fixed Targets

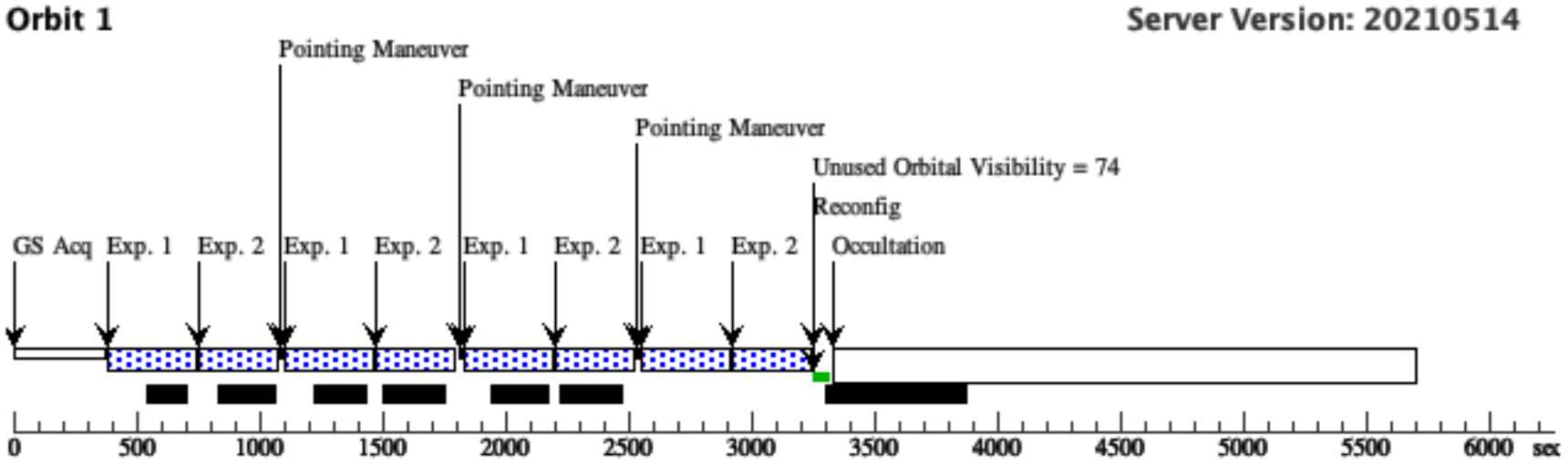
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2011FE	RA: 14 03 5.7110 (210.7737958d) Dec: +54 16 25.22 (54.27367d) Equinox: J2000	Epoch of Position: 2015.5	V=10.06	Reference Frame: SIMBAD

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[SPIRAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F160W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS25; NSAMP=14		Pattern 1, Exps 1-2 in Visit 3 (03) (1)	327.938986 Secs (1311.756 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	F110W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F110W	NSAMP=7; SAMP-SEQ=SPARS50		Pattern 1, Exps 1-2 in Visit 3 (03) (1)	302.934997 Secs (1211.74 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure



Visit

Proposal 16744, Visit 4 (04) Fri Jul 30 17:06:42 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: AFTER 03 BY 65 D TO 85 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1-2)

Fixed Targets

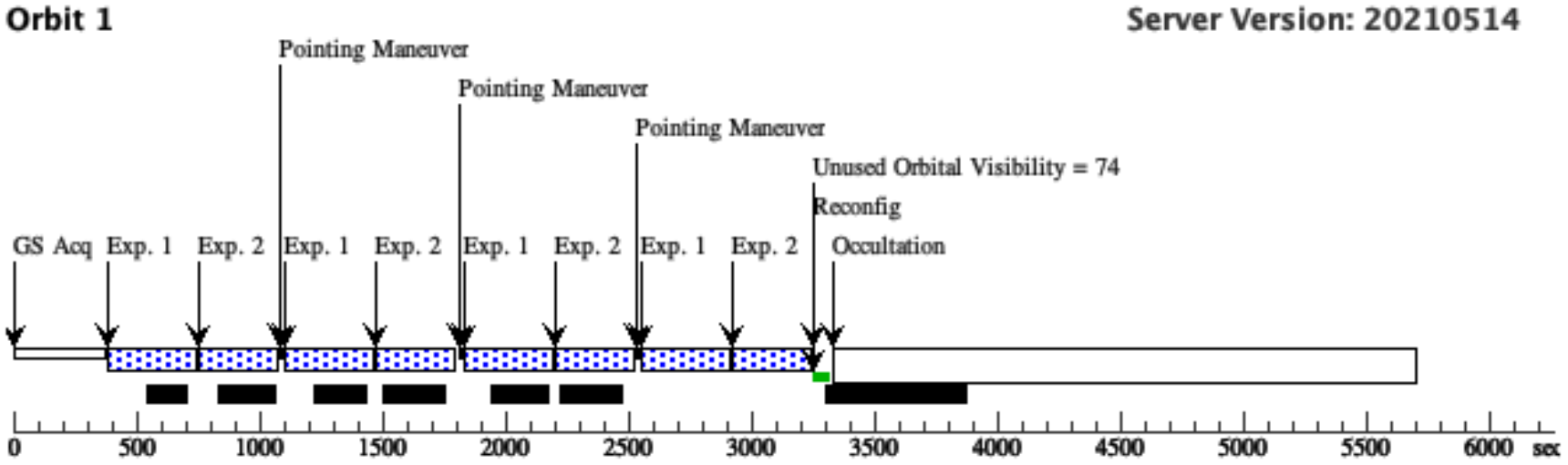
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2011FE	RA: 14 03 5.7110 (210.7737958d) Dec: +54 16 25.22 (54.27367d) Equinox: J2000	Epoch of Position: 2015.5	V=10.06	Reference Frame: SIMBAD

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[SPIRAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F160W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS25; NSAMP=14		Pattern 1, Exps 1-2 in Visit 4 (04) (1)	327.938986 Secs (1311.756 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	F110W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F110W	NSAMP=7; SAMP-SEQ=SPARS50		Pattern 1, Exps 1-2 in Visit 4 (04) (1)	302.934997 Secs (1211.74 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure



Visit

Proposal 16744, Visit 5 (05) Fri Jul 30 17:06:42 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: AFTER 04 BY 110 D TO 130 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1-2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2011FE	RA: 14 03 5.7110 (210.7737958d) Dec: +54 16 25.22 (54.27367d) Equinox: J2000	Epoch of Position: 2015.5	V=10.06	Reference Frame: SIMBAD

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[SPIRAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F160W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS25; NSAMP=14		Pattern 1, Exps 1-2 in Visit 5 (05) (1)	327.938986 Secs (1311.756 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	F110W	(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR-FIX	F110W	NSAMP=7; SAMP-SEQ=SPARS50		Pattern 1, Exps 1-2 in Visit 5 (05) (1)	302.934997 Secs (1211.74 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure