17312 - Refining the Mira Distance Ladder with NIRCam Observations of M101

Cycle: 30, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
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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 ANY	ACS/WFC WFC3/IR	1	29-Jul-2024 15:00:17.0	yes
02	(1) SN-2011FE ANY	ACS/WFC WFC3/IR	1	29-Jul-2024 15:00:18.0	yes
03	(1) SN-2011FE ANY	ACS/WFC WFC3/IR	1	29-Jul-2024 15:00:19.0	yes

3 Total Orbits Used

ABSTRACT

The recent tension between direct, model-independent measurements of the Hubble constant and the model-dependent values inferred from observations of the CMB has posed the strongest challenge to LambdaCDM in nearly 30 years. However, the burden of proof for a potentially

groundbreaking discovery of new physics is high. Thus, alternative routes to the present measurements of the Hubble constant -- which rely primarily on Cepheids and Tip of Red Giant Branch as intermediate distance indicators -- must be explored in order to verify the current results and to fully understand the role of systematic uncertainties. Oxygen-rich Mira variables are luminous, ubiquitous, NIR and IR standard candles and present a particularly compelling path forward to studying the tension in the era of JWST. Here, we propose to use the high angular resolution and infrared coverage of NIRCam to simultaneously refine the Mira-based distance ladder and re-examine Cepheid crowding in the Type Ia Supernova host galaxy M101. This will allow us to verify the Cepheid results by using an independent ladder subject to different systematics, and by directly reanalyzing the Cepheids in M101. In this joint proposal consisting of one epoch of JWST NIRCam and three epochs of coordinated HST WFC3/IR and ACS observations, we will (1) de-blend the backgrounds of known Cepheids and Miras in M101, (2) improve Mira spectral type classification, and (3) study the effect of dust and mass loss on the Mira PLR. The three HST epochs will allow us to phase the single-epoch JWST observations to mean magnitude and produce Mira PLR in JWST bands for the first time.

OBSERVING DESCRIPTION

We propose to observe Cepheids and Mira candidates in the nearby SN Ia host galaxy, M101, with NIRCam in 6 filters (F115W, F150W, F182M, F277W, F356W, and F444W). The observations will be taken in a single epoch. We also request 3 coordinated orbits (split into 3 epochs) of HST observations, one prior to, and one after the JWST obsservations. For HST, we propose WFC3/IR observations (in F160W and F110W filters) and parallel ACS F555W observations to determine the phases of the Miras and Cepheids respectively at the time of the JWST observations.

These observations will allow us to produce Mira PLRs in the NIRCam filters, uncrowd the backgrounds of Cepheids and Miras previously observed in M101, improve our spectral classification of Miras, and reduce the uncertainty in the Hubble constant measurements of both methods.

Visit

Proposal 17312, M101 - 01 (01), completed Mon Jul 29 19:00:20 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: ORIENT 95D TO 115 D; BETWEEN 28-JUN-2023:00:00:00 AND 01-AUG-2023:00:00:00

Diagnostics

(M101 - 01 (01)) Warning (Orbit Planner): INVALID GS ACQ SCENARIO SPECIAL REQUIREMENT

(M101 - 01 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

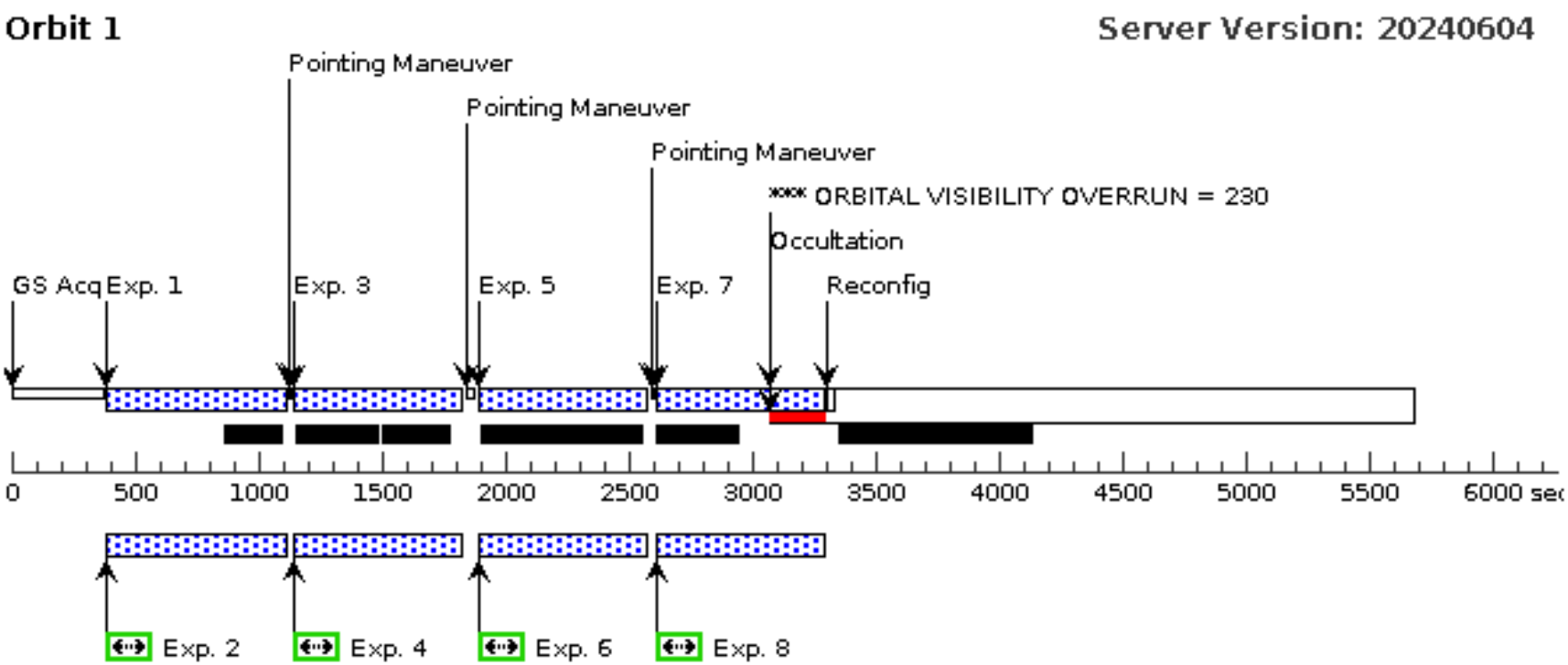
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2011FE	RA: 14 03 5.7110 (210.7737958d) Dec: +54 16 25.22 (54.27367d) Equinox: J2000	Epoch of Position: 2000	V=10.06	Reference Frame: SIMBAD

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		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS50	POS TARG 0,0; GS ACQ SCENARIO PAIR	Prime + Parallel Group 1-2 in M101 - 01 (01)	702.938605 Secs (702.939 Secs) *[==>]*	***[1]***
2		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 1-2 in M101 - 01 (01)	520 Secs (520 Secs) *[==>]*	***[1]***
3		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS50	POS TARG 0.542,0.182; GS ACQ SCENARIO PAIR	Prime + Parallel Group 3-4 in M101 - 01 (01)	652.938154 Secs (652.938 Secs) *[==>]*	***[1]***
4		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 3-4 in M101 - 01 (01)	560 Secs (560 Secs) *[==>]*	***[1]***
5		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS50	POS TARG 0.339,55.485; GS ACQ SCENARIO PAIR	Prime + Parallel Group 5-6 in M101 - 01 (01)	652.938154 Secs (652.938 Secs) *[==>]*	***[1]***
6		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 5-6 in M101 - 01 (01)	560 Secs (560 Secs) *[==>]*	***[1]***
7		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS50	POS TARG -0.203,55.303; GS ACQ SCENARIO PAIR	Prime + Parallel Group 7-8 in M101 - 01 (01)	652.938154 Secs (652.938 Secs) *[==>]*	***[1]***
8		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 7-8 in M101 - 01 (01)	560 Secs (560 Secs) *[==>]*	***[1]***

Orbit Structure



Visit

Proposal 17312, M101 - 02 (02), scheduling Mon Jul 29 19:00:20 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: ORIENT 85D TO 125 D; AFTER 01; BEFORE 31-DEC-2024:00:00:00

Diagnostics

(M101 - 02 (02)) Warning (Orbit Planner): INVALID GS ACQ SCENARIO SPECIAL REQUIREMENT

Fixed Targets

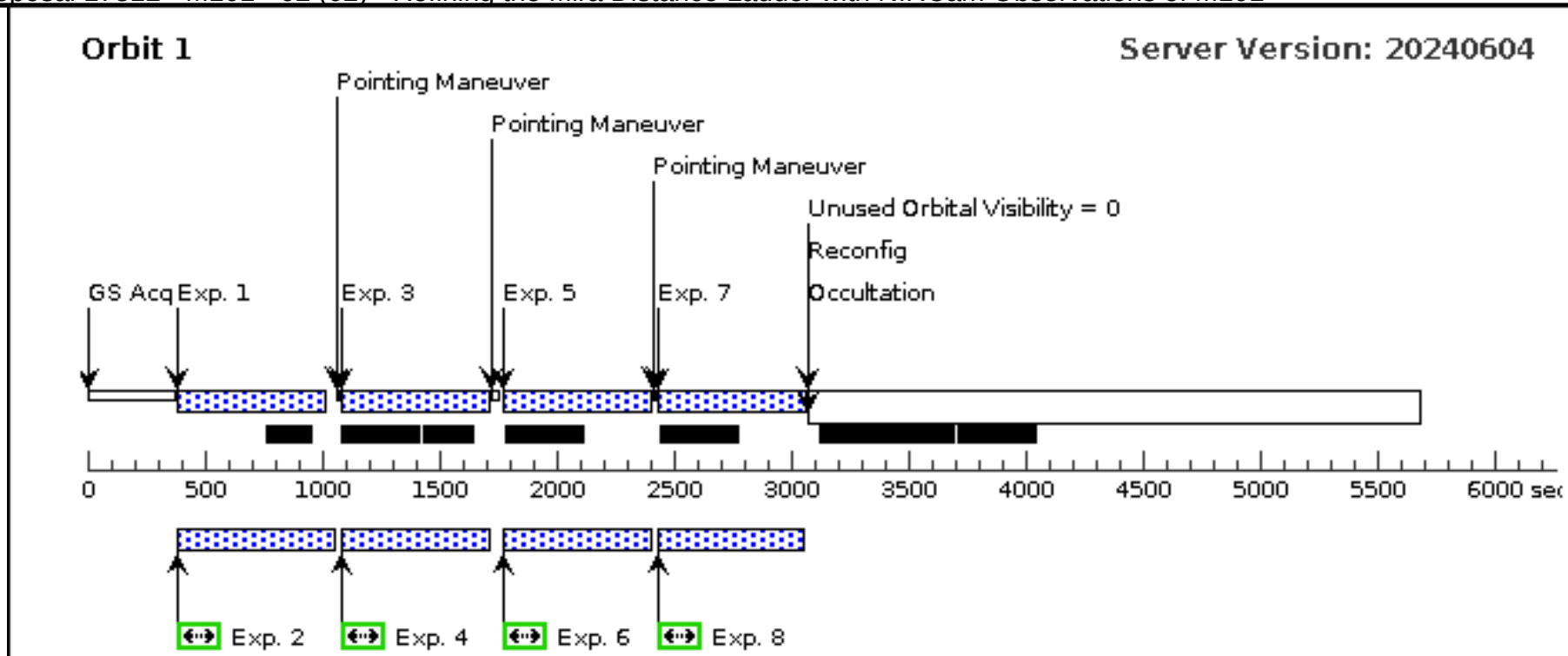
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2011FE	RA: 14 03 5.7110 (210.7737958d) Dec: +54 16 25.22 (54.27367d) Equinox: J2000	Epoch of Position: 2000	V=10.06	Reference Frame: SIMBAD

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		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=13; SAMP-SEQ=SPARS50	POS TARG 0,0; GS ACQ SCENARIO PAIR	Prime + Parallel Group 1-2 in M101 - 02 (02)	602.937703 Secs (602.938 Secs) *[==>]*	 ***[1]***
2		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 1-2 in M101 - 02 (02)	460 Secs (460 Secs) *[==>]*	 ***[1]***
3		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 0.542,0.182; GS ACQ SCENARIO PAIR	Prime + Parallel Group 3-4 in M101 - 02 (02)	602.934229 Secs (602.934 Secs) *[==>]*	 ***[1]***
4		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 3-4 in M101 - 02 (02)	505 Secs (505 Secs) *[==>]*	 ***[1]***
5		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=12; SAMP-SEQ=STEP100	POS TARG 0.339,55.485; GS ACQ SCENARIO PAIR	Prime + Parallel Group 5-6 in M101 - 02 (02)	599.232292 Secs (599.232 Secs) *[==>]*	 ***[1]***
6		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 5-6 in M101 - 02 (02)	505 Secs (505 Secs) *[==>]*	 ***[1]***
7		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=12; SAMP-SEQ=STEP100	POS TARG -0.203,55.303; GS ACQ SCENARIO PAIR	Prime + Parallel Group 7-8 in M101 - 02 (02)	599.232292 Secs (599.232 Secs) *[==>]*	 ***[1]***
8		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 7-8 in M101 - 02 (02)	500 Secs (500 Secs) *[==>]*	 ***[1]***

Orbit Structure



Visit

Proposal 17312, M101 - 01 (03), implementation Mon Jul 29 19:00:20 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: ORIENT 82D TO 128 D; AFTER_02 BY 3 D TO 365 D; BETWEEN 30-JUN-2024:00:00:00 AND 2024.235:00:00:00

Diagnostics

(M101 - 01 (03)) Warning (Orbit Planner): INVALID GS ACQ SCENARIO SPECIAL REQUIREMENT

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: 2000	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		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=13; SAMP-SEQ=SPARS50	POS TARG 0,0; GS ACQ SCENARIO PAIR	Prime + Parallel Group 1-2 in M101 - 01 (03)	602.937703 Secs (602.938 Secs) *[==>]*	 ***[1]***
2		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 1-2 in M101 - 01 (03)	460 Secs (460 Secs) *[==>]*	 ***[1]***
3		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 0.542,0.182; GS ACQ SCENARIO PAIR	Prime + Parallel Group 3-4 in M101 - 01 (03)	602.934229 Secs (602.934 Secs) *[==>]*	 ***[1]***
4		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 3-4 in M101 - 01 (03)	505 Secs (505 Secs) *[==>]*	 ***[1]***
5		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=12; SAMP-SEQ=STEP100	POS TARG 0.339,55.485; GS ACQ SCENARIO PAIR	Prime + Parallel Group 5-6 in M101 - 01 (03)	599.232292 Secs (599.232 Secs) *[==>]*	 ***[1]***
6		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 5-6 in M101 - 01 (03)	505 Secs (505 Secs) *[==>]*	 ***[1]***
7		(1) SN-2011FE	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=12; SAMP-SEQ=STEP100	POS TARG -0.203,55.303; GS ACQ SCENARIO PAIR	Prime + Parallel Group 7-8 in M101 - 01 (03)	599.232292 Secs (599.232 Secs) *[==>]*	 ***[1]***
8		ANY	ACS/WFC, ACCUM, WFCENTER	F555W			Prime + Parallel Group 7-8 in M101 - 01 (03)	500 Secs (500 Secs) *[==>]*	 ***[1]***

Orbit Structure