17000 - A spectroscopic study of the Type Ia supernova near-infrared plateau

Cycle: 30, 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?*
05	(1) SN2021JAD	WFC3/IR	1	23-Jun-2022 10:00:20.0	yes
06	(2) SN2021PIT	WFC3/IR	1	23-Jun-2022 10:00:21.0	yes

2 Total Orbits Used

ABSTRACT

We ask for 6 WFC3 orbits to obtain G141 grism spectra of two Type Ia supernovae (SNe Ia) in order to ascertain why the newly-discovered near-infrared (NIR) year-long plateau at ~150-500 days comes to an end. SNe Ia have long been used as standard candles to measure extragalactic distances and constrain cosmology, yet the nature of their progenitor stars and the physics behind their explosions remain open questions. The recent discovery of the NIR plateau highlights just how much we still have to learn about the physics of these explosions. In this proposal, we aim to learn why the NIR plateau comes to an end at ~450-500 days past maximum light. The discoverers of the plateau proposed that a change in the dominant ionization state of the SN ejecta, from singly-ionized to neutral iron-group lines, may be the cause. However, this explanation rests on a dubious detection of neutral iron lines in a low signal-to-noise (S/N) grism spectrum of a single SN Ia at 600 days. We will obtain higher S/N spectra of two brighter SNe Ia and optimize the orients of our observations to properly subtract any contamination from the bright host galaxies of our targets. This will allow us to unambiguously detect any [Fe I] lines in our spectra, if they exist. By visiting our targets at additional, earlier epochs along the plateau we will also determine whether such [Fe I] lines exist along the plateau, something that could not be done with previous, ground-based spectra where these lines fell in atmospheric absorption bands. The results of our observations will provide fresh constraints on the chemical composition of the progenitors prior to explosion as well as the evolution of the SN ejecta.

OBSERVING DESCRIPTION

In this program, we will obtain WFC3/IR G141 grism spectra of two bright Type Ia supernovae. Each supernova will be visited when it is roughly 300, 450-500, and 600 days beyond maximum light. In each visit, one orbit will be devoted mostly to a G141 observation. The rest will go to an F160W direct image required to reduce the grism data. Four of the orbits will be used in Cycle 29, while two more orbits will be used in Cycle 30 (for the last visit to each supernova).

This program relies on an interplay of timing and rotation angle. On one hand, the spectra should be taken at specific phases of the evolution of the superonvae. On the other, to reduce the contamination of galaxy background light, the are specific orent ranges that would be optimal for this program. The timing requests in this proposal have taken both of these aspects into account. Were HST to transition into reduced-gyro operations, we

would need to look into the possibility of rescheduling our visits to make the best of the new situation. If notified of this in advance, we will promptly evaluate what changes we would need to make and re-submit our phase II.

Visit

Proposal 17000, SN2021jad - decline (05) Thu Jun 23 14:00:21 GMT 2022

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 71D TO 75 D; BETWEEN 24-JAN-2023:00:00:00 AND 31-JAN-2023:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(2)

Fixed Targets

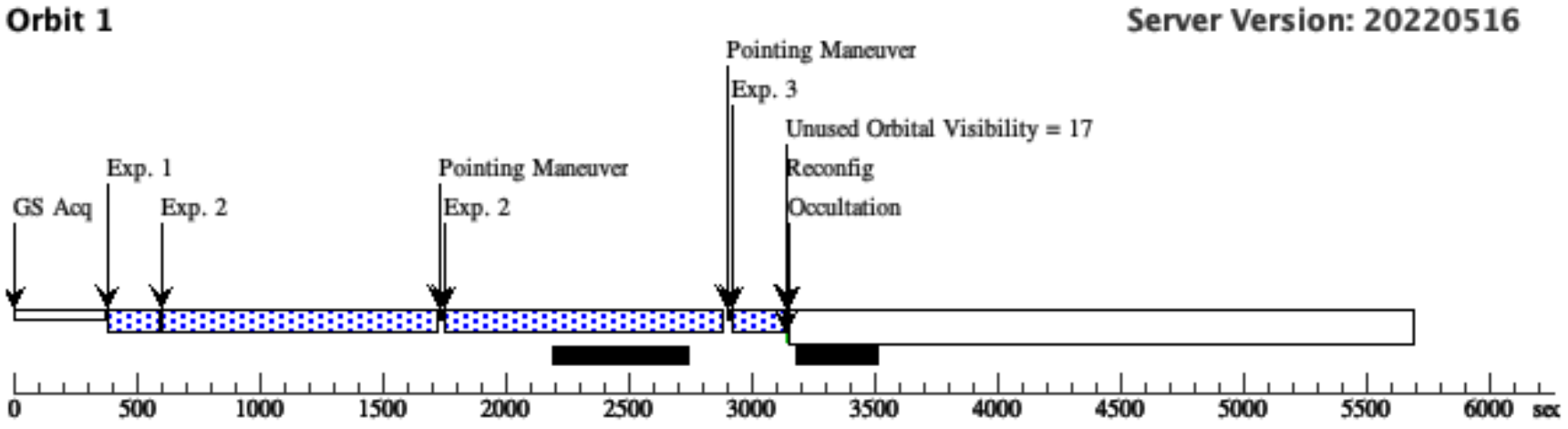
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN2021JAD	RA: 05 33 22.1800 (83.3424167d) Dec: -21 57 6.50 (-21.95181d) Equinox: J2000		V=20	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA TYPE IA]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) SN2021JAD	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPARS25			177.935896 Secs (177.936 Secs) *[==>]*	*[1]*
2		(1) SN2021JAD	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100		Pattern 1, Exps 2-2 in SN2021jad - decline (05) (1)	1102.935844 Secs (2205.872 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	*[1]*
3		(1) SN2021JAD	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPARS25	POS TARG 0.474,0.424		177.935896 Secs (177.936 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 17000, SN2021pit - decline (06) Thu Jun 23 14:00:21 GMT 2022

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 84D TO 88 D; BETWEEN 12-FEB-2023:00:00:00 AND 21-FEB-2023:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SN2021PIT	RA: 03 44 30.1700 (56.1257083d) Dec: -44 37 57.10 (-44.63253d) Equinox: J2000		V=19	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA TYPE IA]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) SN2021PIT	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=10; SAMP-SEQ=SPARS25			227.936926 Secs (227.937 Secs) *[==>]*	*[1]*
2		(2) SN2021PIT	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPARS100		Pattern 1, Exps 2-2 in SN2021pit - decline (06) (1)	1102.935844 Secs (2205.872 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	*[1]*
3		(2) SN2021PIT	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=9; SAMP-SEQ=SPARS25	POS TARG 0.474,0.424		202.936411 Secs (202.936 Secs) *[==>]*	*[1]*

Orbit Structure