15361 - The Mysterious High-Velocity Ejecta Jets in Cassiopeia A

Cycle: 25, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Robert A. Fesen (PI) (Contact)	**Dartmouth College**	**robert.fesen@dartmouth.edu**
Dr. Dan Milisavljevic (CoI)	Smithsonian Institution Astrophysical Observatory	dmilisav@cfa.harvard.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) CAS-A-NE-JET-1	WFC3/IR	2	12-Jul-2017 17:11:51.0	yes
02	(2) CAS-A-NE-JET-2	WFC3/IR	2	12-Jul-2017 17:11:53.0	yes

4 Total Orbits Used

ABSTRACT

The young Galactic remnant Cas A provides perhaps our clearest look at the explosion of a high mass, core-collapse supernova. Two opposing streams or "jets" of high-velocity debris extending outward along its northeastern and southwestern limbs have expansion velocities more than twice that of the remnant's bright main shell. Interpretation of these NE-SW jets has been controversial. However, SN debris located at the farthest tip of the NE jet has been found to be S,Ar,Ca-rich but O-poor suggesting an origin deep inside the progenitor possibly due to an overturning of layers as predicted in some aspherical explosion models.

Recent WFC3/IR images taken of the NE jet revealed a far richer debris field than previously realized, with ejecta knots found out to the very edge of the camera's FOV. This leaves uncertain the jet's true maximum velocity and total kinetic energy. The lack of a complete census of the jet's structure and kinematics critically limits understanding on the nature of these puzzling kinematic and chemically distinct features. We propose to obtain

WFC3/IR images of the remnant's NE jet out beyond existing HST images to complete a survey of its S-rich ejecta and explore the presence of even higher-velocity, Fe-rich ejecta predicted by supernova models. Detection of very high-velocity Fe-rich material in the jet would represent a breakthrough in our understanding of Cas A and core-collapse supernovae in general.

OBSERVING DESCRIPTION

The aim of this project is to obtain WFC3/IR images of two regions near the young supernova remnant, Cassiopeia A, in two filters: the F098M filter to detect [S III] 9069, 9531 and [S II] 10250-10,400 emission lines, while the F160N filter images will detect [Fe II] 1.64 emission from Fe-rich ejecta.

Two adjacent and slightly overlapping fields will be imaged in both filters. We will employ a four point dither pattern for these images. The features we are trying to detect are small (0.5" or less)
emission blobs using the F098M filter, and eitehr small ejecta knots/blobs of patches of diffuse emission in the F164N images.

These images will serve as the first set of images to be combined with a nearly identical set of images taken in Cycle 25.

Visit

Proposal 15361, Visit 01, implementation Wed Jul 12 21:11:54 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 111.7D TO 112.1 D; AFTER 01-OCT-2018; GROUP 01,02 WITHIN 60D

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

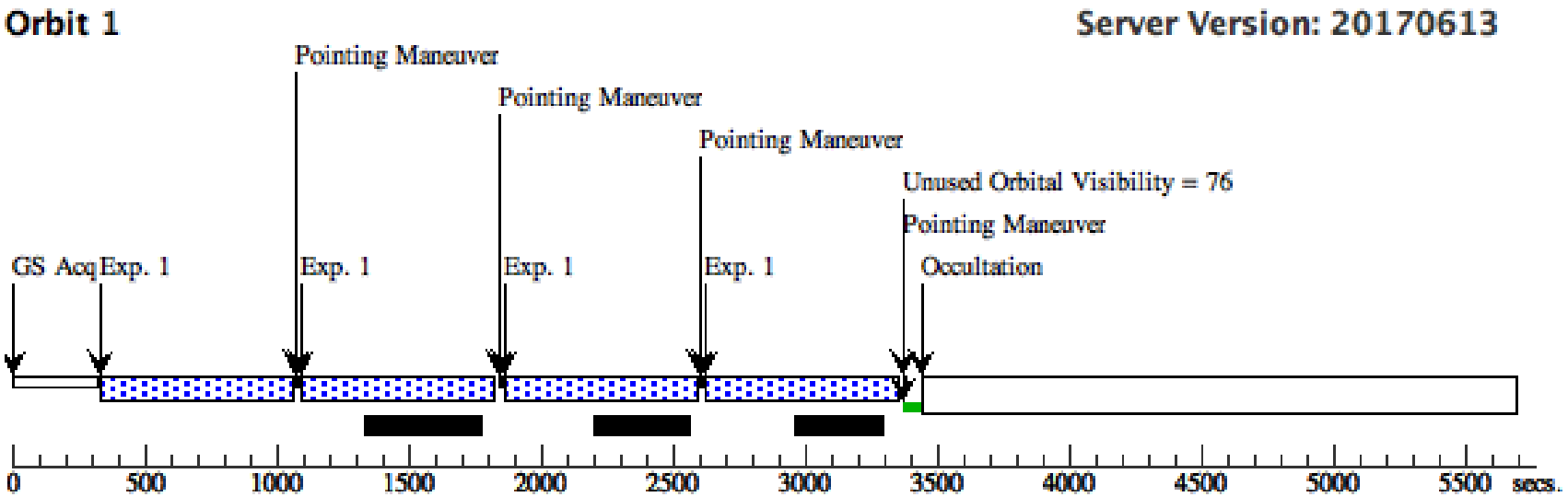
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	CAS-A-NE-JET-1	RA: 23 24 2.0000 (351.0083333d) Dec: +58 51 0.00 (58.85000d) Equinox: J2000		V=24+/-2	Reference Frame: ICRS

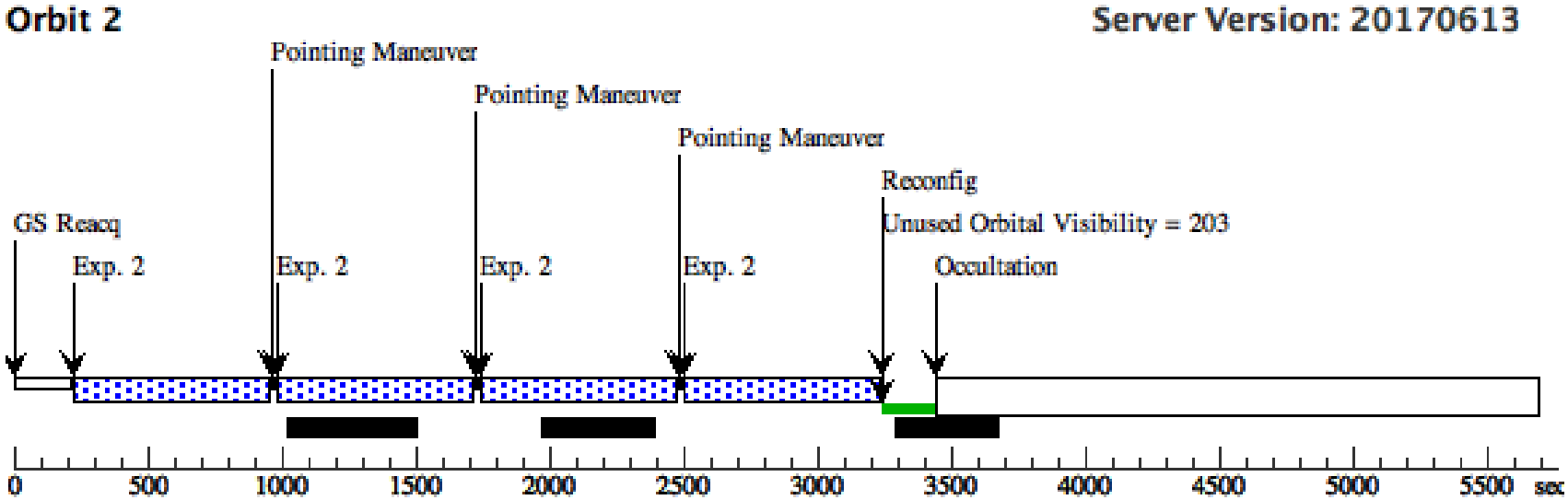
Comments: Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	CAS_A_JET_1_F098M	(1) CAS-A-NE-JET-1	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=15; SAMP-SEQ=SPARS50		Pattern 1, Exps 1-1 in Visit 01 (1)	702.938605 Secs (2811.754 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	CAS_A_JET_1_F164N	(1) CAS-A-NE-JET-1	WFC3/IR, MULTIACCUM, IR-FIX	F164N	NSAMP=13; SAMP-SEQ=STEP100		Pattern 1, Exps 2-2 in Visit 01 (1)	699.232615 Secs (2796.93 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***

Orbit Structure





Visit

Proposal 15361, Visit 02, implementation Wed Jul 12 21:11:54 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 111.7D TO 112.1 D; AFTER 01-OCT-2018

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
(2)	CAS-A-NE-JET-2	RA: 23 24 17.0000 (351.0708333d) Dec: +58 51 50.00 (58.86389d) Equinox: J2000		V=25+/-2	Reference Frame: ICRS

Comments: Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	CAS_A_JET_2_F098M	(2) CAS-A-NE-JET-2	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=15; SAMP-SEQ=SPARS50		Pattern 1, Exps 1-1 in Visit 02 (1)	702.938605 Secs (2811.754 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	CAS_A_JET_2_F164N	(2) CAS-A-NE-JET-2	WFC3/IR, MULTIACCUM, IR-FIX	F164N	NSAMP=13; SAMP-SEQ=STEP100		Pattern 1, Exps 2-2 in Visit 02 (1)	699.232615 Secs (2796.93 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***

Orbit Structure