12674 - A Deep Kinematic Investigation of Cas A's Opposing High-Velocity Ejecta Jets

Cycle: 19, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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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) CAS-A-SW-JET-NORTH (2) CAS-A-SW-JET-SOUTH (3) CAS-A-SW (4) CAS-A-NW (5) CAS-A-CENTRAL-NORTH (6) CAS-A-CENTRAL-SOUTH	WFC3/IR	3	29-Sep-2011 21:11:50.0	yes
02	(7) CAS-A-NE (8) CAS-A-EAST (9) CAS-A-NE-JET-SOUTH (10) CAS-A-NE-JET-NORTH	WFC3/IR	2	29-Sep-2011 21:12:04.0	yes

5 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 seemingly 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 jets has been controversial mainly based on energy considerations. However, SN debris located at the farthest tip of the NE jet is S-rich suggesting an origin deep inside the progenitor due to an overturning of layers as predicted in some aspherical explosion models. If similar ejecta were also found present in the SW jet's outermost knots, it would be strong evidence in support of an asymmetric explosion of Cas A and in turn for CCSNe in general. Unfortunately, substantial extinction toward both jets has prevented a thorough investigation of their properties and, in particular, whether they constitute a true bipolar outflow.

We propose to use the WFC3/IR channel in 5 CVZ orbits to obtain a deep imaging survey of Cas A's jets to probe their true extent and structure. The combination of WFC3's high throughput at the [S II] 10287-10370 and [S III] 9069, 9531 emission lines, a pixel scale well matched to typical jet knot sizes, and decreased extinction at 1 micron will dramatically improve jet knot detections over prior ACS/WFC images. Follow-up observations in Cycle 19 will allow robust knot identification via proper motions, and KPNO 4m near-IR spectroscopy will provide knot radial velocities. Our goal is to develop a thorough 3D kinematic and chemical map of Cas A's jets which will constrain their nature and relationship to the remnant's main spherical shell of ejecta.

OBSERVING DESCRIPTION

The goal is to image both outer NE and SW ejecta "jets" (high-velocity streams of SN debris) in the Cas A supernova remnant, as well as part of the main shell.

Visit

Proposal 12674, Visit 01, implementation Fri Sep 30 01:12:10 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: CVZ; ORIENT 111.5D TO 112.5 D

Comments: please schedule at U3=112

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), (3), (4), (5), (6)

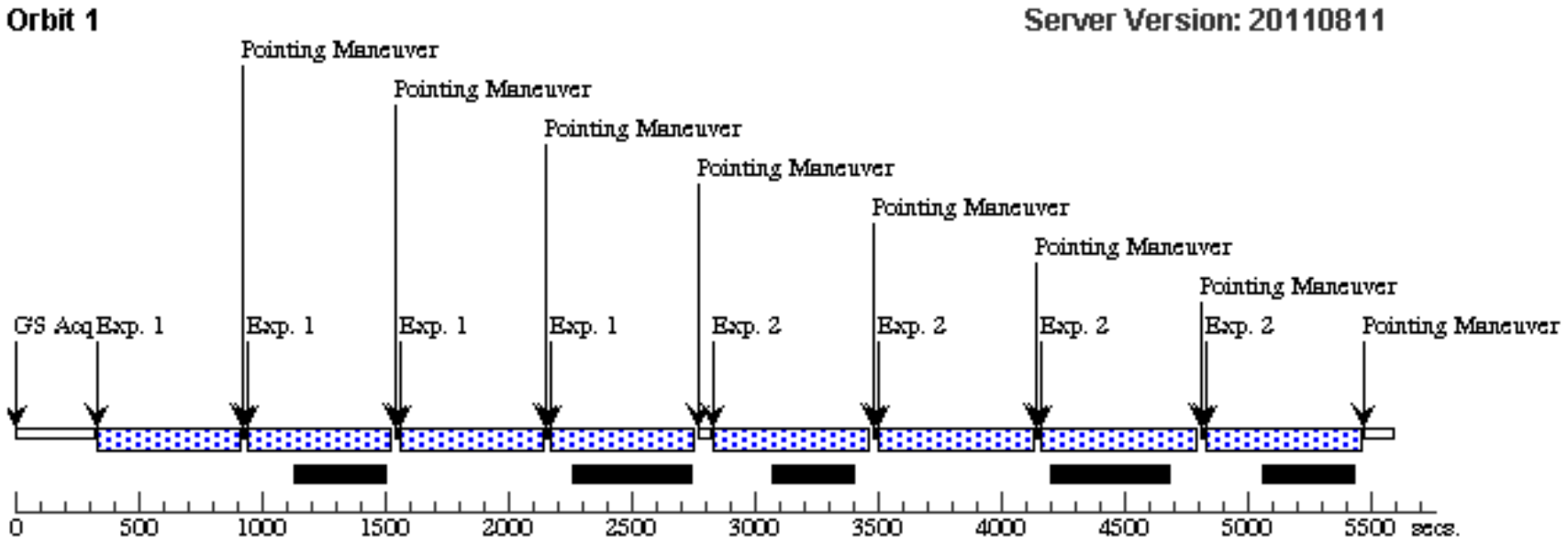
Fixed Targets

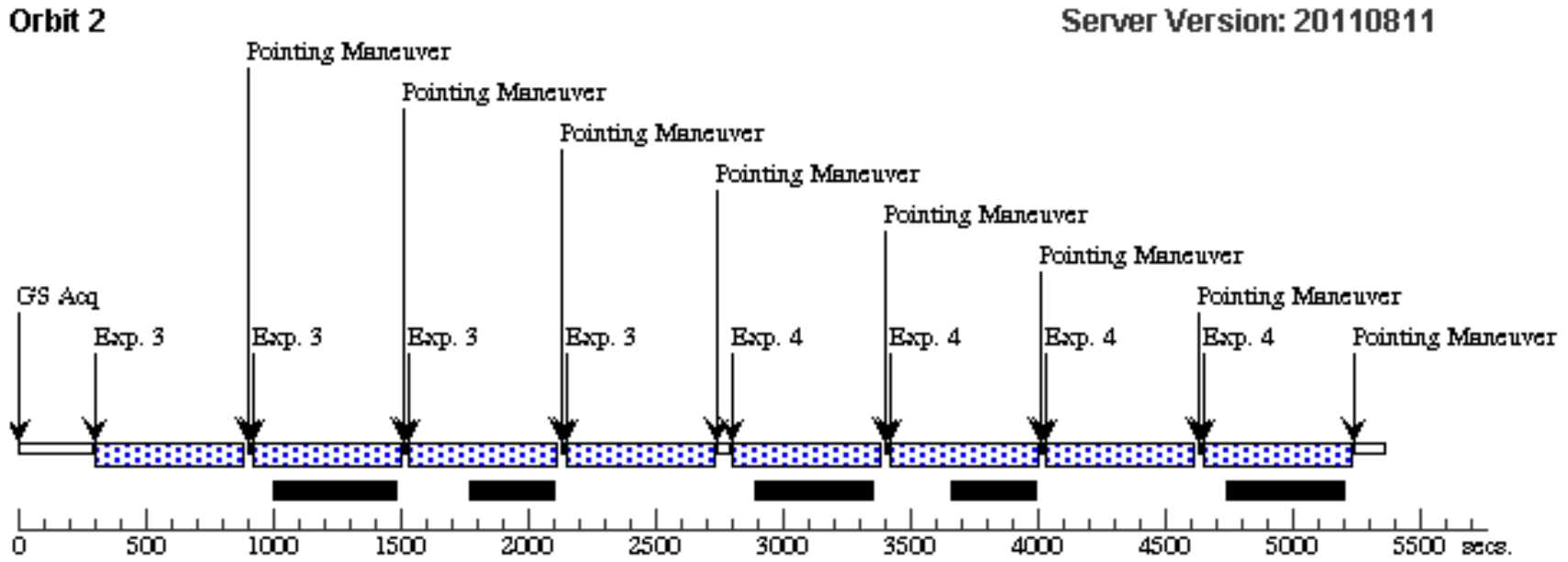
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	CAS-A-SW-JET-NORTH	RA: 23 22 56.1812 (350.7340883d) Dec: +58 48 18.63 (58.80518d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS
(2)	CAS-A-SW-JET-SOUTH	RA: 23 23 1.6473 (350.7568638d) Dec: +58 46 39.09 (58.77752d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS
(3)	CAS-A-SW	RA: 23 23 16.1402 (350.8172508d) Dec: +58 47 27.19 (58.79089d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS
(4)	CAS-A-NW	RA: 23 23 10.6741 (350.7944754d) Dec: +58 49 6.77 (58.81855d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS
(5)	CAS-A-CENTRAL-NORTH	RA: 23 23 25.1669 (350.8548621d) Dec: +58 49 54.80 (58.83189d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS
(6)	CAS-A-CENTRAL-SOUTH	RA: 23 23 30.6331 (350.8776379d) Dec: +58 48 15.19 (58.80422d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS

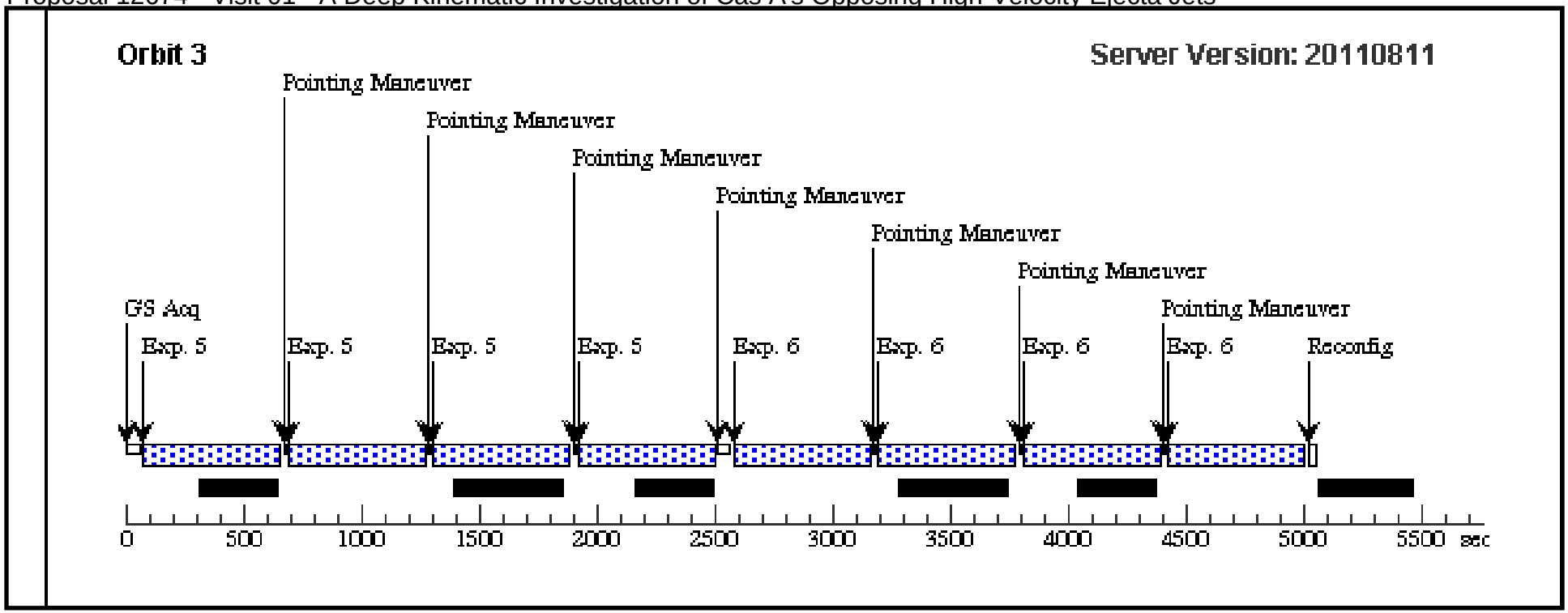
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) CAS-A-SW-JET-NORTH	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=12	GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in Visit 01 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2		(2) CAS-A-SW-JET-SOUTH	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=13		Pattern 1, Exps 2-2 in Visit 01 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
3		(3) CAS-A-SW	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=12	GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 3-3 in Visit 01 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
4		(4) CAS-A-NW	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=12		Pattern 1, Exps 4-4 in Visit 01 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
5		(5) CAS-A-CENTRAL-NORTH	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=12	GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 5-5 in Visit 01 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[3]***
6		(6) CAS-A-CENTRAL-SOUTH	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=12		Pattern 1, Exps 6-6 in Visit 01 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[3]***

Orbit Structure



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Visit

Proposal 12674, Visit 02, implementation Fri Sep 30 01:12:13 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: CVZ; SAME ORIENT AS 01

Comments: please schedule at U3 112-112.5

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), (3), (4)

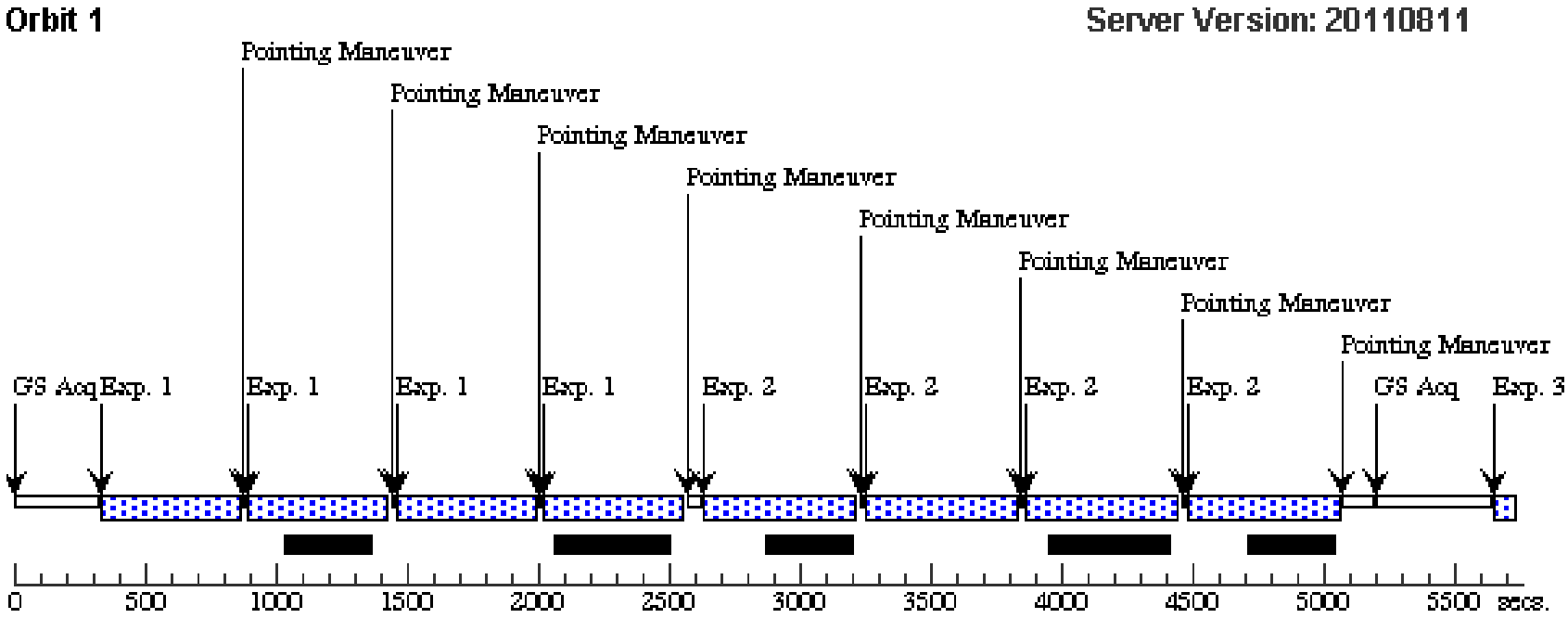
Fixed Targets

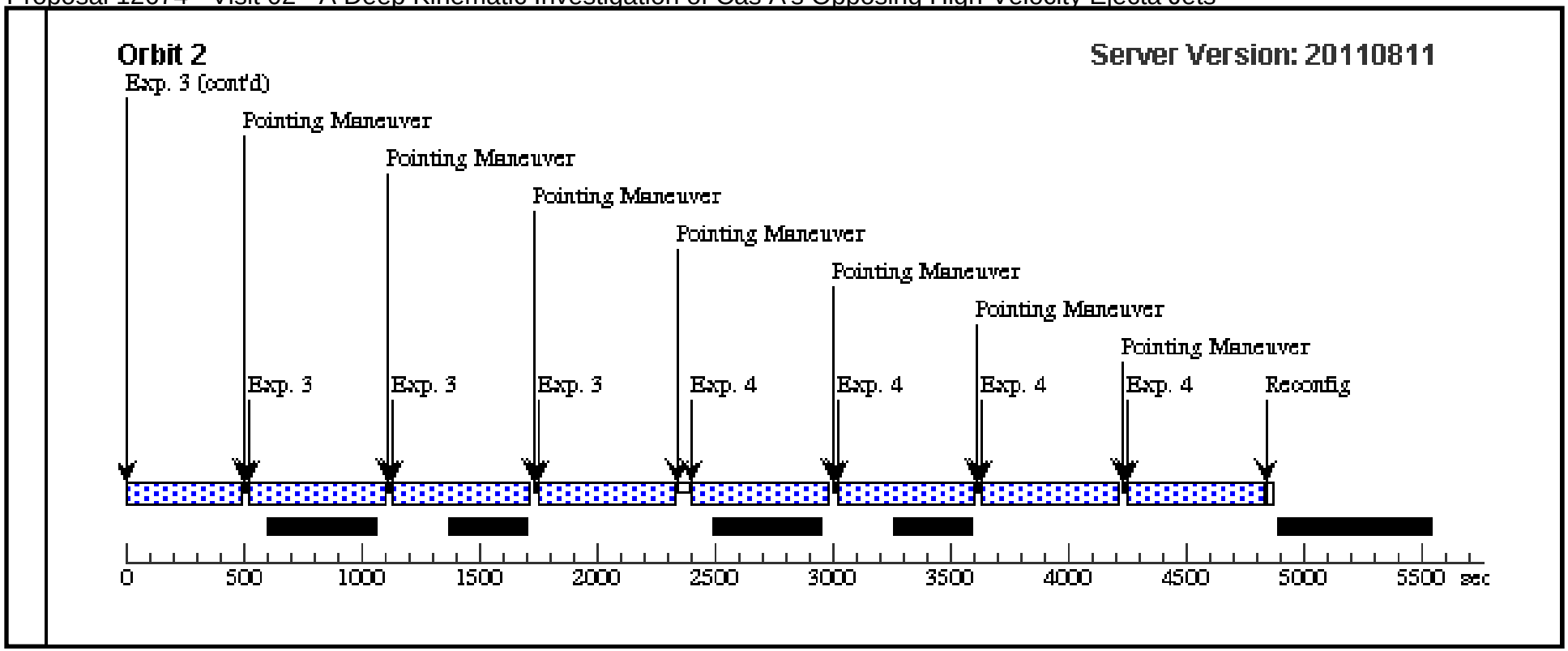
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(7)	CAS-A-NE	RA: 23 23 39.6598 (350.9152492d) Dec: +58 50 42.74 (58.84521d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS
(8)	CAS-A-EAST	RA: 23 23 45.1259 (350.9380246d) Dec: +58 49 3.09 (58.81752d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS
(9)	CAS-A-NE-JET-SOUTH	RA: 23 23 59.6188 (350.9984117d) Dec: +58 49 50.89 (58.83080d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS
(10)	CAS-A-NE-JET-NORTH	RA: 23 23 54.1527 (350.9756362d) Dec: +58 51 30.58 (58.85849d) Equinox: J2000		V=21.0+/-2.0	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(7) CAS-A-NE	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=11	GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in Visit 02 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2		(8) CAS-A-EAST	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=12		Pattern 1, Exps 2-2 in Visit 02 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
3		(9) CAS-A-NE-JET-SOUTH	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=12	GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 3-3 in Visit 02 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]*** ***[2]***
4		(10) CAS-A-NE-JET-NORTH	WFC3/IR, MULTIACCUM, IR-FIX	F098M	SAMP-SEQ=SPARS50; NSAMP=12		Pattern 1, Exps 4-4 in Visit 02 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***

Orbit Structure

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Exp. 4
Exp. 4
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