



16707 - Precision astrometry with STIS to confirm the orbital motion of HD 106906b

Cycle: 29, Proposal Category: GO
(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) HD-106906	STIS/CCD	1	06-Jan-2023 16:02:05.0	yes
02	(1) HD-106906	STIS/CCD	1	06-Jan-2023 16:02:06.0	yes

2 Total Orbits Used

ABSTRACT

The 15 Myr old spectroscopic binary HD 106906 represents a unique laboratory for studying the early dynamical evolution of planetary systems because a gas giant exoplanet has been directly imaged exterior to a central planetary system and a distorted debris disk. Several groups have proposed that the planet has been ejected from its formation site near the binary and dynamically shapes the outer disk structure, much like the hypothetical Planet Nine in our solar system is thought to control the orbital architecture of detached Kuiper Belt Objects. A key test of this hypothesis is to measure the orbital elements of HD 106906b which requires exquisite astrometric precision over many years given its 737 au separation from the binary. Using multi-epoch HST imaging with ACS, WFC3 and STIS where background stars detected with Gaia are used as an astrometric reference frame, Nguyen et al. (2021) recently measured orbital motion and constrained the orbit of HD 106906b. The findings were

consistent with the hypothesis that the planet perturbs the disk. However, the result strongly depends on a single ACS/HRC point from 2004 that cannot be reproduced given that the camera is no longer functional. Here we propose to reproduce their 2017 STIS observations in Cycle 29, five years after the planet was first imaged with STIS. The sky-plane motion over this interval is expected to be greater than 3-sigma of the astrometric uncertainty. These observations will serve as a critical validation using the same instrument for two epochs of astrometry and will refine the estimated posteriors of the planetary orbital elements.

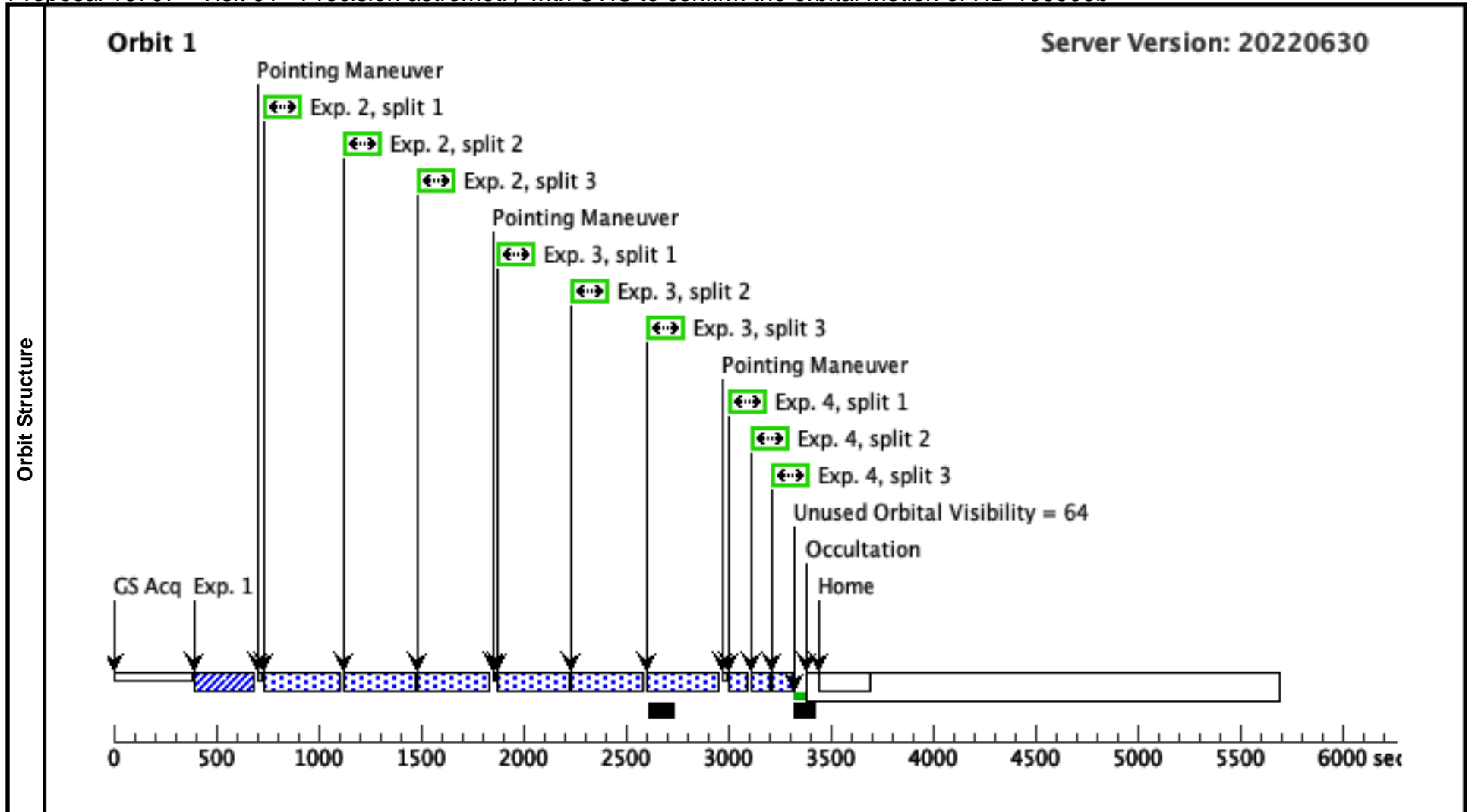
OBSERVING DESCRIPTION

- (1) To mitigate the effects of uncorrected geometric distortion, we aim to place HD 106906b in the central region of the STIS field. This is achieved by occulting the star at the WEDGE1.8 position and using the specified ORIENTs.
- (2) HD 106906 is a bright star ($m_v = 7.8$ mag) and its PSF halo interferes with the detection of its debris disk as well as the planet located at 7.1" radius from the star. To achieve PSF subtraction we will image the science target at two roll angles.
- (3) We image at the WEDGE1.8 position, and also at a POS-TARG $X=-0.5''$ away from this position, thus achieving additional dithering for PSF analysis.
- (4) The best PSF subtractions occur when the the orbits are executed consecutively. Therefore, in Visit 01 we specify a timing SEQUENCE which should have consecutive orbits and not be interrupted by other types of observations.

Proposal 16707 - Visit 01 - Precision astrometry with STIS to confirm the orbital motion of HD 106906b

Fri Jan 06 21:02:06 GMT 2023

Visit		Proposal 16707, Visit 01, scheduling Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD Special Requirements: ORIENT 320.0D TO 320.1 D; SEQ 01.02 WITHIN 1.1 Orbits								
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	HD-106906	RA: 12 17 53.1914 (184.4716308d) Dec: -55 58 31.89 (-55.97553d) Equinox: J2000	Proper Motion RA: -39.014 mas/yr Proper Motion Dec: -12.872 mas/yr Parallax: 0.0096774" Epoch of Position: 2000.0	V=8.89	Reference Frame: ICRS				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=STAR Description=[DISK, EXTRA-SOLAR PLANET, EXTRA-SOLAR PLANETARY SYSTEM, F3-F9]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) HD-106906	STIS/CCD, ACQ, F25ND3	MIRROR				1.0 Secs (1 Secs)	
									[==>]	[1]
	2		(1) HD-106906	STIS/CCD, ACCUM, WEDGE1.8	MIRROR	CR-SPLIT=3; GAIN=4			960 Secs (960 Secs)	
									[==>(Split 1)] [==>(Split 2)] [==>(Split 3)]	[1]
3	dither X=-0.5 arcsec	(1) HD-106906	STIS/CCD, ACCUM, WEDGE1.8	MIRROR	CR-SPLIT=3; GAIN=4	POS TARG -0.5,0		960 Secs (960 Secs)		
								[==>(Split 1)] [==>(Split 2)] [==>(Split 3)]	[1]	
4	PosTarg X=-17 arcsec on B Wedge	(1) HD-106906	STIS/CCD, ACCUM, WEDGE1.8	MIRROR	CR-SPLIT=3; GAIN=4	POS TARG -17,0		180 Secs (180 Secs)		
								[==>(Split 1)] [==>(Split 2)] [==>(Split 3)]	[1]	



Proposal 16707 - Visit 02 - Precision astrometry with STIS to confirm the orbital motion of HD 106906b

Fri Jan 06 21:02:06 GMT 2023

Visit		Proposal 16707, Visit 02, scheduling Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD Special Requirements: ORIENT 338.5D TO 338.6 D								
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	HD-106906	RA: 12 17 53.1914 (184.4716308d) Dec: -55 58 31.89 (-55.97553d) Equinox: J2000	Proper Motion RA: -39.014 mas/yr Proper Motion Dec: -12.872 mas/yr Parallax: 0.0096774" Epoch of Position: 2000.0	V=8.89	Reference Frame: ICRS				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=STAR Description=[DISK, EXTRA-SOLAR PLANET, EXTRA-SOLAR PLANETARY SYSTEM, F3-F9]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) HD-106906	STIS/CCD, ACQ, F25ND3	MIRROR				1.0 Secs (1 Secs)	
									[==>]	[1]
	2		(1) HD-106906	STIS/CCD, ACCUM, WEDGE1.8	MIRROR	CR-SPLIT=3; GAIN=4			960 Secs (960 Secs)	
									[==>(Split 1)] [==>(Split 2)] [==>(Split 3)]	[1]
3	dither X=-0.5 arcsec	(1) HD-106906	STIS/CCD, ACCUM, WEDGE1.8	MIRROR	CR-SPLIT=3; GAIN=4	POS TARG -0.5,0		960 Secs (960 Secs)		
								[==>(Split 1)] [==>(Split 2)] [==>(Split 3)]	[1]	
4	PosTarg X=-17 arcsec on B Wedge	(1) HD-106906	STIS/CCD, ACCUM, WEDGE1.8	MIRROR	CR-SPLIT=3; GAIN=4	POS TARG -17,0		180 Secs (180 Secs)		
								[==>(Split 1)] [==>(Split 2)] [==>(Split 3)]	[1]	

