14196 - The Very Low Mass Object FW Tau b: An Edge-on Brown Dwarf Disk or a Planet Caught in Formation?

Cycle: 23, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Gregory J. Herczeg (PI) (Contact)	**Peking University**	**gherczeg1@gmail.com**
Dr. Sean M Andrews (CoI)	Smithsonian Institution Astrophysical Observatory	sandrews@cfa.harvard.edu
Dr. Brendan Bowler (CoI)	University of Texas at Austin	bpbowler@caltech.edu
Dr. Michael J. Ireland (CoI)	Australian National University	michael.ireland@anu.edu.au
Dr. Adam L. Kraus (CoI) (AdminUSPI)	University of Texas at Austin	alk@astro.as.utexas.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) FW-TAU-B (2) V-FW-TAU CCDFLAT	STIS/CCD	3	26-May-2016 21:11:16.0	yes

3 Total Orbits Used

ABSTRACT

Planetary mass companions to solar mass stars may form through core accretion, gravitational instabilities in the disk, or protostellar core fragmentation. Recent searches have uncovered about 15 planetary mass companions to young Sun-like stars in orbits of 50-300 AU from the central star. These objects pose significant challenges for formation theories. One particular object, FW Tau b, may be caught in the process of formation. FW Tau b has an apparent brightness and colors consistent with an early L-dwarf, bright emission lines consistent with strong accretion, heavy K-

band veiling due to warm dust, and a spatially resolved jet. However, the object mass is not known because the accretion/disk signatures veil the photosphere and have prevented detection of photospheric features and along with a precise measurement of spectral type or temperature. We propose to use STIS G750L to obtain a deep red-optical spectrum of this very faint and enigmatic object to measure its spectral type and thereby infer its mass. If the photosphere is visible, an M-dwarf SpT would mean that the object is a brown dwarf obscured by an edge-on disk. An L-dwarf SpT would indicate a planetary mass object with strong accretion. If entirely veiled, this object would have a remarkably high accretion rate, consistent with it being caught either in its main formation stage or in outburst. A wealth of data, including HST optical photometry, Keck-AO near-IR spectra, and ALMA observations, all suggest that FW Tau b is a very low mass companion at an important stage of evolution. These STIS data are crucial to finally tie these observations together with a SpT and refined mass estimate of this object.

OBSERVING DESCRIPTION

The goal of this program is to obtain a STIS long slit spectrum of a faint secondary located 2.28" away from the primary star. The primary star is an equal-luminosity 0.1 arcsec binary.

Step 1: acquire primary star with centroid
Step 2: offset to faint secondary
Step 3: Integrate (2.5 orbits)

Step 1: flux-weighted centroid on a 0.1 arcsec binary over 5x5 arcsec. I think that this should work well to get the centroid of the binary with an error less than the eventual slit width. There's another similar-luminosity source at 12" away, but that should be far enough to not mess up the acquisition. I put in 1.5s, which guarantees excellent S/N without coming close to saturation. Used Pickles MV as a template.

Step 2: Offset. I've calculated, re-calculated, and checked several times the offset. Still, it might be useful to check that, e.g., +/- are correct. There's no "offset" button, right, I just put in the correct target coordinate offsets into the Fixed Targets list?

Step 3: Integrate; Include flatfield at the end of each visit.

ORIENT CONSTRAINT: As stated in the Phase I proposal, we don't want the primary falling at the same location as FW Tau in the cross dispersion direction, even with the 2" separation. The PA is 295.5. So the bad positions are 205.5 and 20.5. Then ORIENT=PA+45, so the bad ORIENT

positions are 250 and 65. We have set the VISIT constraints to rule out those slit orientations.

The ORIENT constraint is also set so that the slit is not placed along the diffraction spikes from the primary (within 10 degrees).

Visit

Proposal 14196, Visit 01, implementation Fri May 27 01:11:18 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: ORIENT 180D TO 235 D; ORIENT 265D TO 320 D; ORIENT 0D TO 55 D; ORIENT 85D TO 140 D

Comments: ORIENT set so that primary does not fall parallel to secondary on the slit.

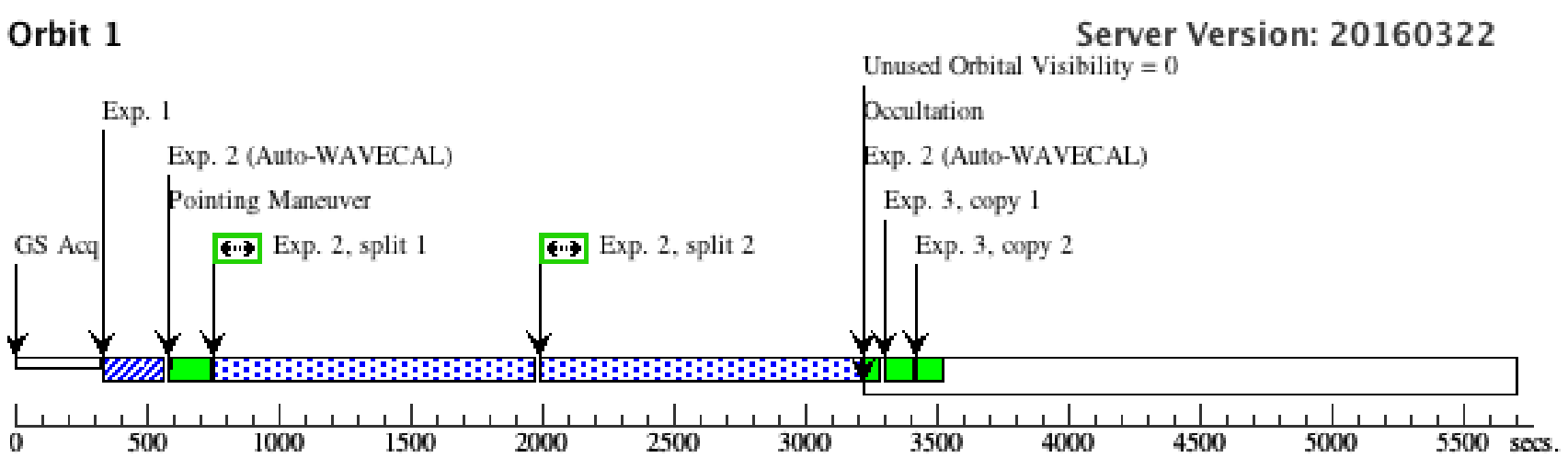
Fixed Targets

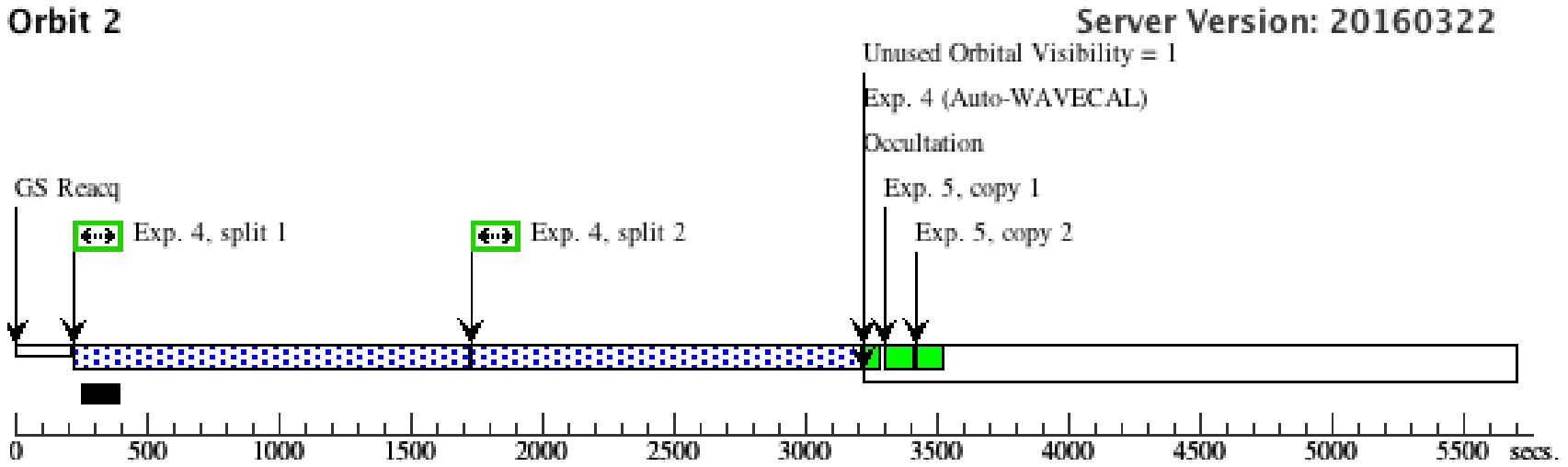
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	FW-TAU-B	Offset from V-FW-TAU RA Offset: -0.153 Secs Dec Offset: 0.981 Arcsec		V=23.0+/-0.3 primary for acquisition is R=15. 9	Offset Position (FW-TAU-B)
	Comments: Position is 2.278 arcsec from primary, PA=295.5, so it's N and W of the primary. *Extended=NO*				
(2)	V-FW-TAU	RA: 04 29 29.7080 (67.3737833d) Dec: +26 16 52.92 (26.28137d) Equinox: J2000	Proper Motion RA: 8.3 mas/yr Proper Motion Dec: -15.5 mas/yr Epoch of Position: 2012.044	V=16.1	Reference Frame: ICRS
	Comments: Position is from: ibsm24070_drz.fit *Extended=NO*				

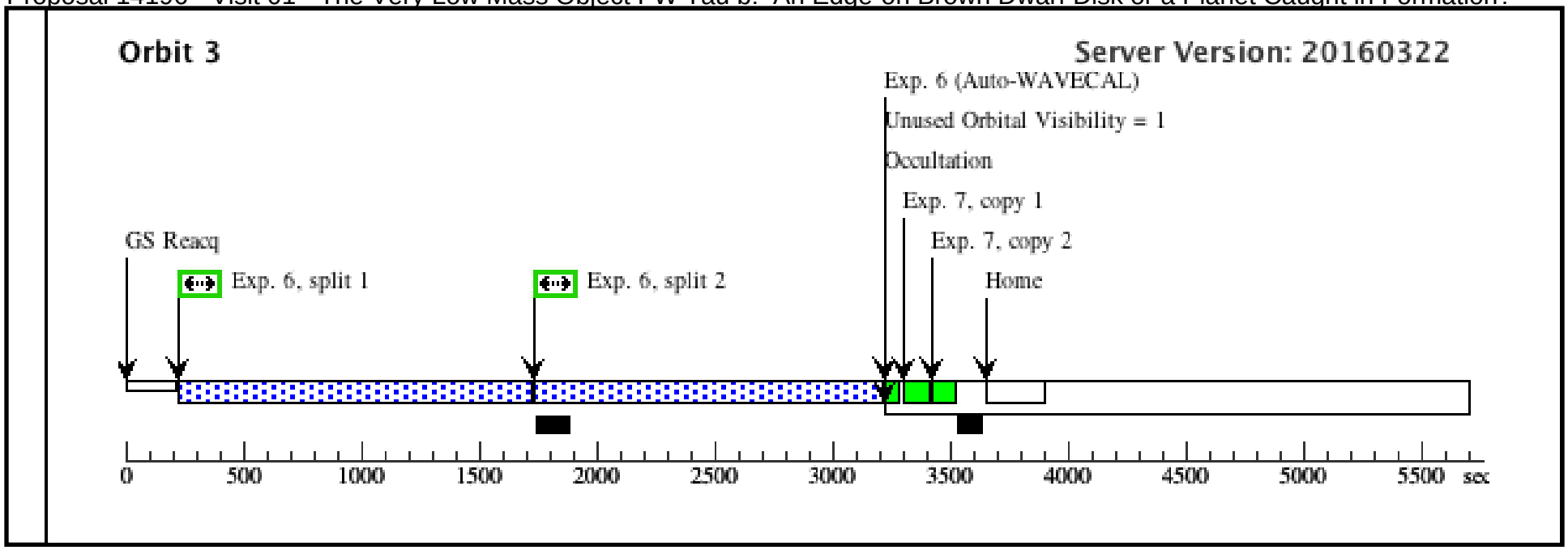
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) V-FW-TAU	STIS/CCD, ACQ, F28X50LP	MIRROR				1.5 Secs (1.5 Secs)	
								[==>]	***[1]***
2		(1) FW-TAU-B	STIS/CCD, ACCUM, 52X0.2	G750L 7751 A	CR-SPLIT=2			2382 Secs (2382 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***
3		CCDFLAT	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***
4		(1) FW-TAU-B	STIS/CCD, ACCUM, 52X0.2	G750L 7751 A	CR-SPLIT=2			2896 Secs (2896 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[2]***
5		CCDFLAT	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[2]***
6		(1) FW-TAU-B	STIS/CCD, ACCUM, 52X0.2	G750L 7751 A	CR-SPLIT=2			2896 Secs (2896 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[3]***
7		CCDFLAT	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[3]***

Orbit Structure






Orbit 3
Server Version: 20160322
Exp. 6 (Auto-WAVECAL)
Unused Orbital Visibility = 1
Occultation
Exp. 7, copy 1
Exp. 7, copy 2
GS Reacq
Exp. 6, split 1
Exp. 6, split 2
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec