11682 - An HST/STIS spectroscopic investigation: is Kelu-1 AB a brown dwarf - brown dwarf binary?

Cycle: 17, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Ms. Micaela B. Stumpf (PI) (ESA Member)	**Max-Planck-Institut fur Astronomie, Heidelberg**	**stumpf@mpia-hd.mpg.de**
Dr. Wolfgang Brandner (CoI) (ESA Member)	Max-Planck-Institut fur Astronomie, Heidelberg	brandner@mpia.de
Prof. Thomas K. Henning (CoI) (ESA Member)	Max-Planck-Institut fur Astronomie, Heidelberg	henning@mpia-hd.mpg.de
Dr. Herve Bouy (CoI) (ESA Member)	Instituto de Astrofisica de Canarias	bouy@iac.es
Dr. Viki Joergens (CoI) (ESA Member)	Max-Planck-Institut fur Astronomie, Heidelberg	joergens@mpia-hd.mpg.de
Dr. Rainer Koehler (CoI) (ESA Member)	Landessternwarte Heidelberg	rkoehler@lsw.uni-heidelberg.de

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) KELU1-AB CCDFLAT WAVE	STIS/CCD	5	03-Jul-2008 22:35:56.0	yes

5 Total Orbits Used

ABSTRACT

We propose to obtain resolved HST/STIS spectroscopy for the benchmark binary brown dwarf Kelu-1 AB. Dynamical masses are being obtained by monitoring the orbital motion using ground-based telescopes with adaptive optics. The main goal of this program is to study the Li I resonance line at

670.8 nm and investigate if only one or even both components bear lithium. This observation will be compared to model predictions of lithium depletion as a function of age and mass, and including our model independent ground-based mass estimations, hence will provide an observational test to the theory of substellar objects. Spin-offs will be the measurement of the strength of H-alpha emission, an indicator of chromospheric activity in cool atmospheres, and comparing the shape of the optical continuum with model spectra with different dust opacities. Thus our program will be an important step towards the understanding of brown dwarf atmospheres and to establish precise models for their formation and evolution.

OBSERVING DESCRIPTION

Our observation will be performed with the Space Telescope Imaging Spectrograph (STIS). To achieve the main goal of our program, the adequate identification and study of the Li I resonance line in the resolved spectra of the components, a minimum resolution of ~ 5000 is required to achieve a dispersion of ~ 1.3 A. This can be achieved by using the G750M grating with lambda_c = 6768 A.
Simulations with the STIS ETC indicate that using the G750M grating with the 52x0.2E1 slit in CR-SPLIT mode (to gain redundancy against cosmic ray events) together with an effective exposure time of 11000 s, we should be able to reach a S/N ratio of ~15 (for R = 19.2 mag) in order to facilitate an accurate measurement of the spectral line equivalent widths (EW) of Li I and H-alpha. Since our target is pretty faint we will use the 'pseudo-aperture' to mitigate the CTE and to reduce the chance of hot/bad pixels in the spectra we will dither the objects along the slit after each orbit with POS TARG. Standart STIS target acquisition for point sources will suffice to place both components of the binary brown dwarf in the 0.2 arcsec wide slit. Including guide star acquisition and re-acquisition, as well as all other instrumental overheads, this observing sequence adds up to 4 orbits.

We add a lower-resolution observation (resolving power 530-1040) with the G750L grating, covering the whole wavelength regime from 525 to 1027 nm. This regime includes many additional important spectral features like the alkali resonance lines and molecular bands which are sensitive to temperature, gravity and metallicity and will help to derive optical spectral types. Previous observations with this low-resolution grating of STIS indicate that it is sufficient enough to resolve those spectral features but not the Li resonance line.
For the G750L with the same slit and CR-SPLIT mode the ETC predicts a S/N ratio of ~34 (for I=16.8 mag) at 750nm for an effective exposure time of 2922 s. Our experience exemplify that this ratio will provide a spectra which will be sufficient enough for a convincing comparison with model atmospheres. Including acquisitions and a CCD flat (which will be carried out during occultation) this fits in one orbit. Therefore the total number of 5 orbits will be used.

Every orbit will include an observer-specified wavelength calibration in addition to the automatic wavecals, either during guide-star acquisition or during occultation, to receive wavelength calibrations at the beginning and at the end of each orbit.

REAL TIME JUSTIFICATION

To place both binary components simultaneously into the long slit, a specific orientation of HST (position angle) is necessary as defined in the Visit Orientation Requirements.
In addition we like to request to schedule the observation as early as possible, since current orbital predictions of the binary system suggest a soon turn-around with following decreasing distance, resulting in a decreasing capability of STIS to clearly resolve the binary at a later scheduled observation.

ADDITIONAL COMMENTS

We like to request to schedule the observation as early as possible, since current orbital predictions of the binary system suggest a soon turn-around with following decreasing distance, resulting in a decreasing capability of STIS to clearly resolve the binary at a later scheduled observation.

Visit

Proposal 11682, Visit 01 Fri Jul 04 02:36:03 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: ORIENT 84.0D TO 92.0 D; ORIENT 264.0D TO 272.0 D

Comments: ORIENT angle calculation: Binary system with position angle of 223D on the sky. Slit position along the line of companions. Add 45D offset angle for U3 axis, results in PA 268D or 88D (if flipped by 180D). A tolerance of 4D is allowed.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	KELU1-AB	RA: 13 05 40.1960 (196.4174833d)	Proper Motion RA: -0.021s/yr	V=22.1	Reference Frame: ICRS
		Dec: -25 41 5.99 (-25.68500d)	Proper Motion Dec: -0.03"/yr	R = 19.2,	
		Equinox: J2000	Epoch of Position: 2000	I = 16.8	

Comments: L1 + L3, d=18.6pc

Exposures

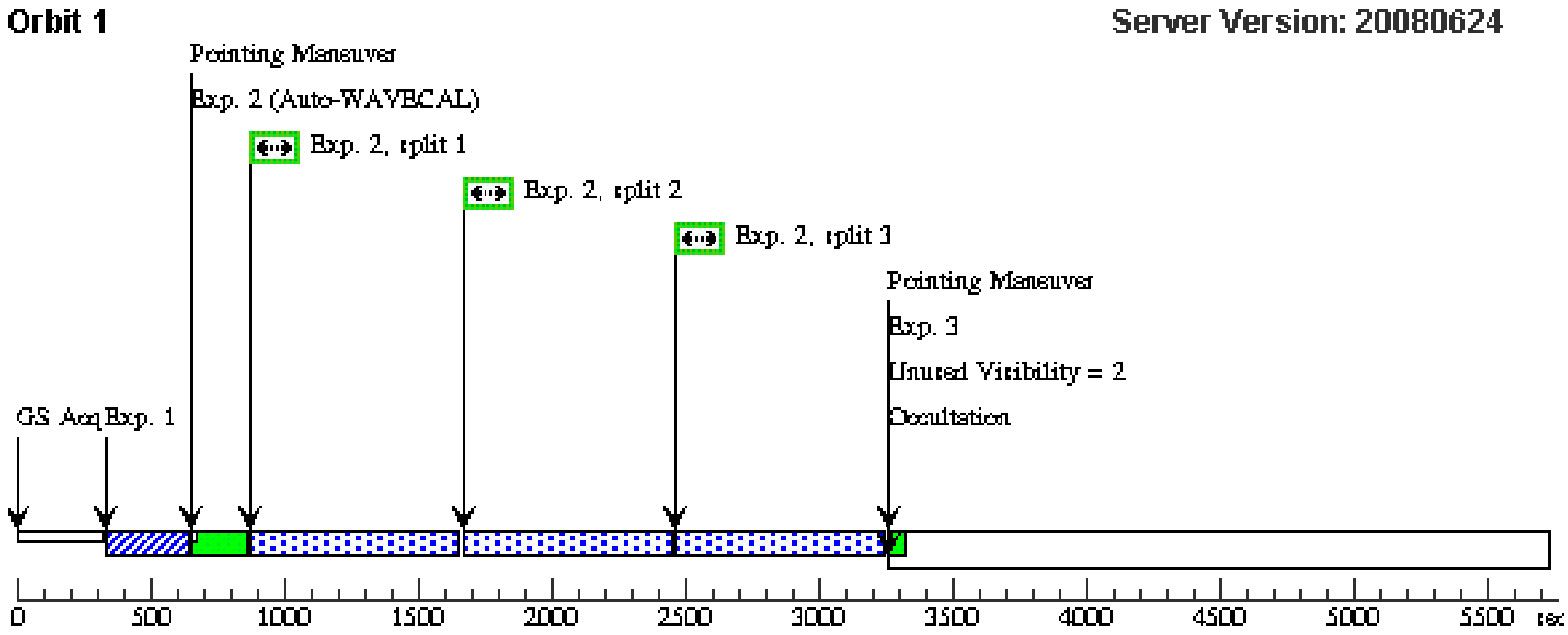
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) KELU1-AB	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT		Sequence 1-3 Non-Int	20 Secs	
								[==>]	***[1]***
Comments: Acquisition of brown dwarf binary									
2		(1) KELU1-AB	STIS/CCD, ACCUM, 52X0.2E1	G750M 6768 A	CR-SPLIT=3		Sequence 1-3 Non-Int	2250 Secs	
								[==>(Split 1)]	
								[==>(Split 2)]	***[1]***
								[==>(Split 3)]	
3		WAVE	STIS/CCD, ACCUM, 52X0.2	G750M 6768 A			Sequence 1-3 Non-Int	*[==>]*	***[1]***
4		(1) KELU1-AB	STIS/CCD, ACCUM, 52X0.2E1	G750M 6768 A	CR-SPLIT=3	POS TARG 0,0.1	Sequence 4-4 Non-Int	2931 Secs	
								[==>(Split 1)]	
								[==>(Split 2)]	***[2]***
								[==>(Split 3)]	
5		WAVE	STIS/CCD, ACCUM, 52X0.2	G750M 6768 A			Sequence 5-6 Non-Int	*[==>]*	***[3]***
6		(1) KELU1-AB	STIS/CCD, ACCUM, 52X0.2E1	G750M 6768 A	CR-SPLIT=3	POS TARG 0,-0.1	Sequence 5-6 Non-Int	2931 Secs	
								[==>(Split 1)]	
								[==>(Split 2)]	***[3]***
								[==>(Split 3)]	
7		WAVE	STIS/CCD, ACCUM, 52X0.2	G750M 6768 A			Sequence 7-8 Non-Int	*[==>]*	***[4]***
8		(1) KELU1-AB	STIS/CCD, ACCUM, 52X0.2E1	G750M 6768 A	CR-SPLIT=3	POS TARG 0,-0.2	Sequence 7-8 Non-Int	2931 Secs	
								[==>(Split 1)]	
								[==>(Split 2)]	***[4]***
								[==>(Split 3)]	

Exposures (continued)

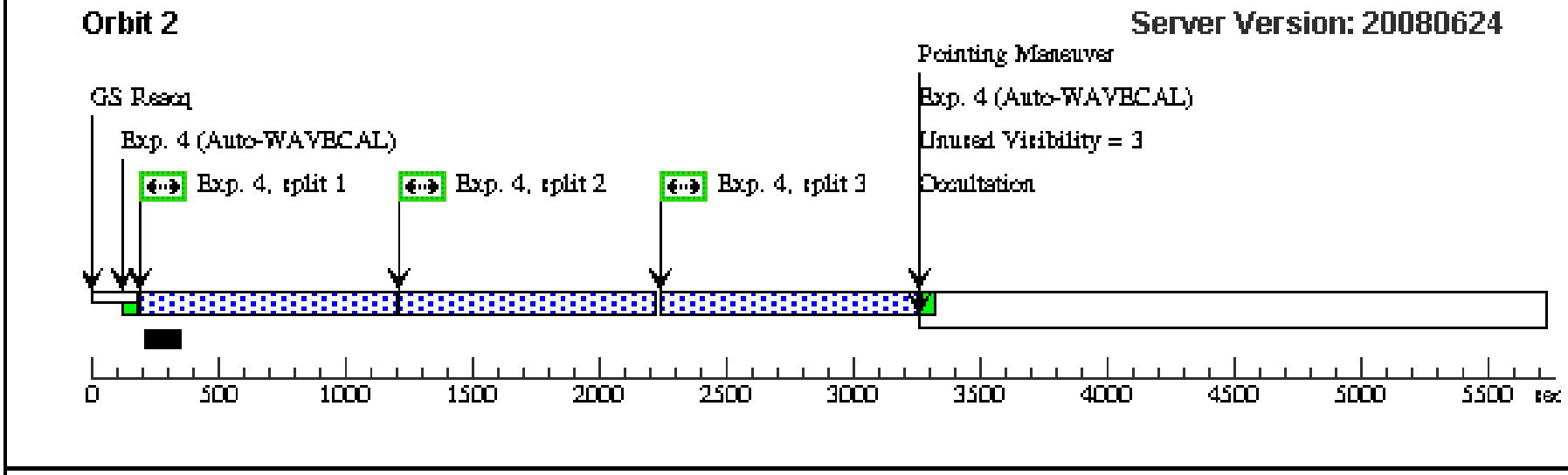
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
9		(1) KELU1-AB	STIS/CCD, ACCUM, 52X0.2E1	G750L 7751 A	CR-SPLIT=3	SAME POS AS 2	Sequence 9-10 Non-Int	2922 Secs *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]*	***[5]***
10		CCDFLAT	STIS/CCD, ACCUM, 52X0.2	G750L 7751 A			Sequence 9-10 Non-Int	*[==>(Copy 1)]* *[==>(Copy 2)]*	***[5]***

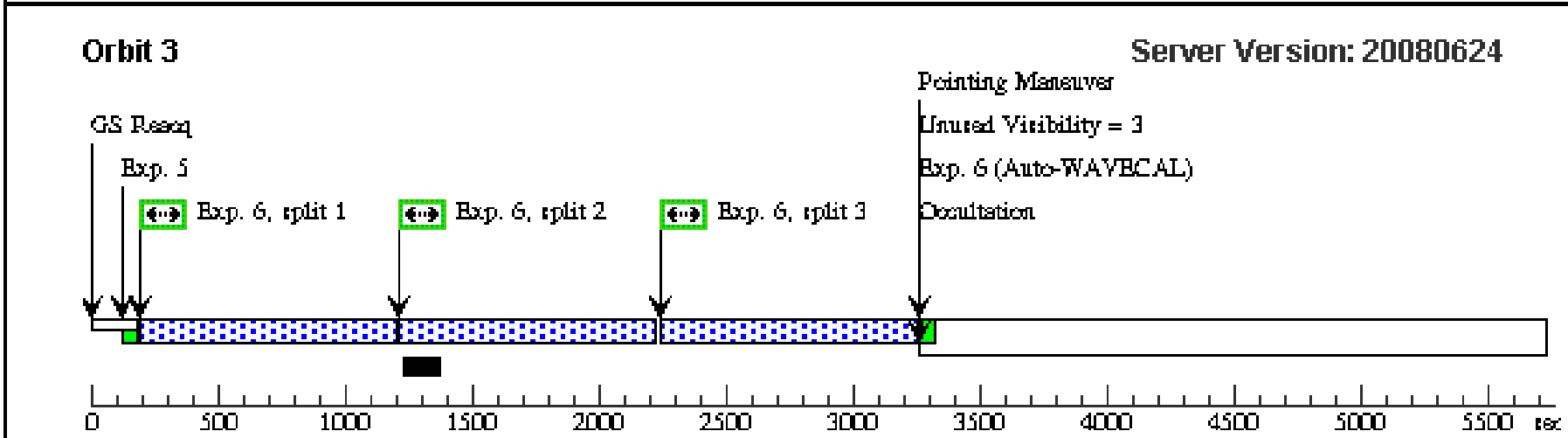
Comments: Flat Field. Must be taken at the same central wavelength with the same aperture as the target.

Orbit Structure



Orbit Structure (continued)





Orbit Structure (continued)