14330 - Astrometric search for Planets in the closest Brown Dwarf Binary system Luhman 16AB

Cycle: 23, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
06	(5) LUHMAN16ABMINAPNE1	WFC3/UVIS	1	11-Jul-2018 18:00:17.0	yes
11	(7) LUHMAN16AB-RICCIOLO-1	WFC3/UVIS	1	11-Jul-2018 18:00:19.0	yes

2 Total Orbits Used

ABSTRACT

Located at 2.0 pc, the L8+T1 dwarfs system Luhman16AB is the third closest system known to Earth, making it a key benchmark for detailed investigation of brown dwarf atmospheric properties, thermal evolution, multiplicity and planet-hosting frequency. Indeed, a recent ground-based astrometric campaign suggested this system to host a 5-30 Jupiter masses exoplanet.

We propose to use HST in spatial-scanning mode to obtain the most accurate annual parallax of any brown dwarf to date, achieving an unprecedented accuracy of 1 part in 10000 (50 micro-arcsecond) for each of the two components of Luh16, and to constrain their absolute space motions with similar accuracy. Most importantly, we will be able to confirm the giant planet candidate and to search for faint companions co-moving with the targets, either resolved or through astrometric perturbations of the A-B orbital motion, the latter probing down to few Earth-masses.

Present-day ground-based direct imaging and AO facilities have fundamental limitations (field of view, PSF stability, differential chromatic effects, visibility) which introduce systematic and seasonal errors that are hard to quantify, and which have already resulted many times in clamorous false alarm in the recent past. This is particularly true for faint and red objects.

Luhman 16A and B will be problematic for GAIA (faint, color, crowding, visibility), and the here proposed HST spatial-scanning mode observations will actually be an important complementary validation of the final GAIA catalog itself (expected 2020). Similarly, JWST is not expected to provide any better astrometry than HST because of its broader and irregular PSFs.

OBSERVING DESCRIPTION

Each visit is scheduled in a 4-10 days window, centered at a well defined epoch.
These epochs are choose as to better constraints the maxima elongation along the major and minor axis
of the annual parallax of Luh16AB, its proper motions, the cusp and curve of the resulting cycloid combined motions,
and to sample presence of possible extrasolar planets with periods between ~15 days and ~6months.

Three epochs are taken at the maxima elongation along the annual parallax semi-major axis.
Five epochs at the maxima elongations along the semi-minor axis of the annual parallax.
Three epochs are taken at the cycloid (pms+annaual annual parallax) curles of the Luh16AB proper motions (visits labeled "ricciolo"),
and two epochs at the bottom of the cycloid motion (visits labeled "pancia").
For total of 3+5+3+2 = 13 epochs.
Eleven of these epochs should be taken within Cycle 22, and the last two within Cycle 23.
The first epoch should be taken as early as possible (this should be in this August 29th, 2014).

Each epoch contains three images in point source imaging mode, and four in spatial-scanning mode with WFC3/UVIS.

In addition to the images taken in spatial scan mode and to the short two point-source images at the beginning and at the end of the single orbit-visits --- as requested at the phase I stage --- it turned out possible to fit in the orbit one extra point source images of 348s in F606W. The color information will be a precious to discriminate the nature (and so the distance) of the reference sources in the field (for example to separate slow close by red dwarf from far away giants).

Visit

Proposal 14330, 2016-10-05 mAP_NE_3 (06), completed Wed Jul 11 22:00:20 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 220D TO 220 D; BETWEEN 01-OCT-2016 AND 11-OCT-2016

Comments: Epoch 2016-10-05.
This is the epoch is taken at the minimum NE-elongation in the minor axis of the annual parallax (AP).
The epococh must be around 2016-10-05 +/- 25 days
Then we want to scan perpendicularly to the minor axis.
ORIENTATION = ~ 90d or ~270d +/- 35d
main SCAN along Y, where CTE are worse, so SCAN ORIENT.
secondary SCAN along X.

A suitalbe window seems to be between 28 September 2015 and 15 Oct 2016. The closer to the Oct 5th 2016, the better.

Diagnostics

(Exposure 2 (2016-10-05 mAP_NE_3 (06))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 3 (2016-10-05 mAP_NE_3 (06))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 4 (2016-10-05 mAP_NE_3 (06))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 5 (2016-10-05 mAP_NE_3 (06))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 6 (2016-10-05 mAP_NE_3 (06))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

Fixed Targets

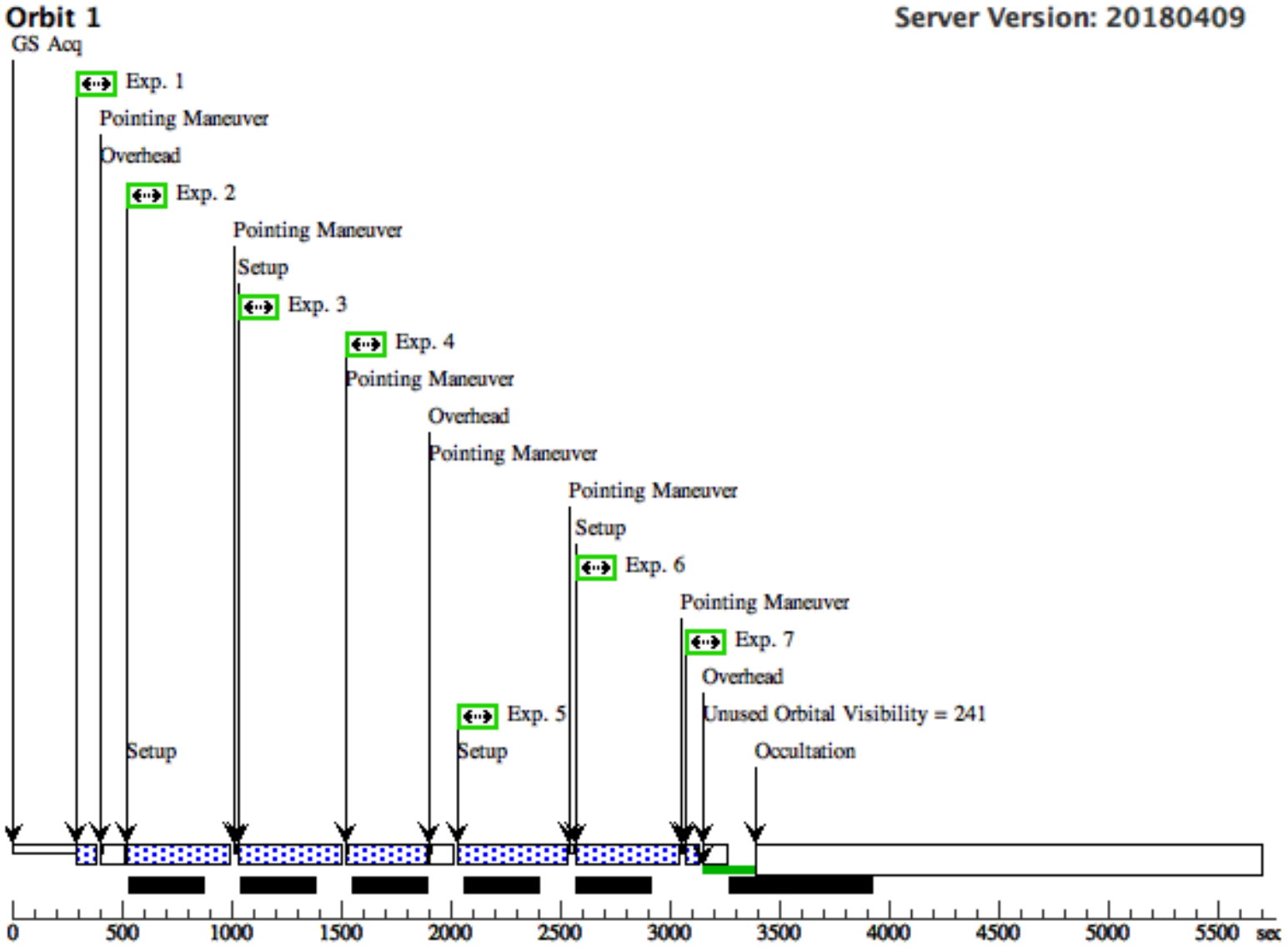
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	LUHMAN16ABMINAPNE1	RA: 10 49 16.5000 (162.3187500d) Dec: -53 19 40.00 (-53.32778d) Equinox: J2000		V=24+/-1 Sloan-i = 15 +/- .5	Reference Frame: ICRS

Comments: We have mapped the relative path of Luhman 16AB between 2014 and 2016
Category=STAR
Description=[BROWN DWARF]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(5) LUHMAN16ABMINAPNE1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG -4,4		60 Secs (60 Secs) *[==>]*	 ***[1]***
2		(5) LUHMAN16ABMINAPNE1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG -4,4; SPATIAL SCAN 0.0 12,270.0 Degrees,Forward		348 Secs (348 Secs) *[==>]*	 ***[1]***
3		(5) LUHMAN16ABMINAPNE1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG -4,-4; SPATIAL SCAN 0.0 12,0.0 Degrees,Forward		348 Secs (348 Secs) *[==>]*	 ***[1]***
4		(5) LUHMAN16ABMINAPNE1	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=12	POS TARG 0,0		348 Secs (348 Secs) *[==>]*	 ***[1]***
5		(5) LUHMAN16ABMINAPNE1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG 4,4; SPATIAL SCAN 0.0 12,180.0 Degrees,Forward		348 Secs (348 Secs) *[==>]*	 ***[1]***
6		(5) LUHMAN16ABMINAPNE1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG 4,-4; SPATIAL SCAN 0.0 12,90.0 Degrees,Forward		348 Secs (348 Secs) *[==>]*	 ***[1]***
7		(5) LUHMAN16ABMINAPNE1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG 4,-4		60 Secs (60 Secs) *[==>]*	 ***[1]***

Orbit Structure



Visit

Proposal 14330, 2016-08-29 Ricciolo_3 (11), implementation Wed Jul 11 22:00:20 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 160D TO 165 D; BETWEEN 20-AUG-2018 AND 23-AUG-2018

Comments: Epoch 2016-08-29.
This is the epoch is taken at the ricciolo of the cycloid apparent motion.
The epoch must be around 2016-08-29 +/- 15 days
main SCAN along Y, where CTE are worse, so SCAN ORIENT.
secondary SCAN along X.

Diagnostics

(Exposure 2 (2016-08-29 Ricciolo_3 (11))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 3 (2016-08-29 Ricciolo_3 (11))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 4 (2016-08-29 Ricciolo_3 (11))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 5 (2016-08-29 Ricciolo_3 (11))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 6 (2016-08-29 Ricciolo_3 (11))) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

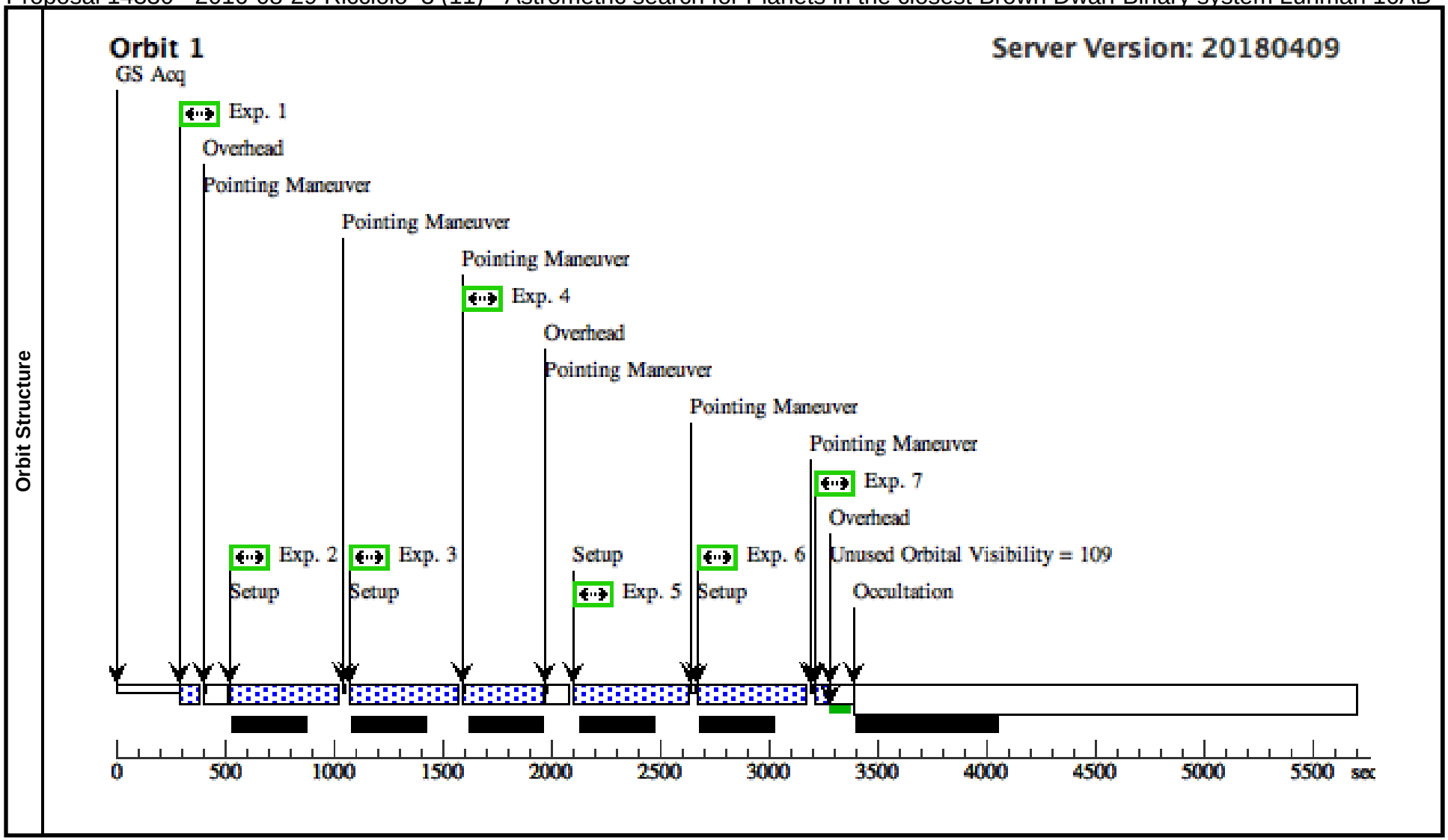
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(7)	LUHMAN16AB-RICCIOLO-1	RA: 10 49 15.0000 (162.3125000d) Dec: -53 19 12.00 (-53.32000d) Equinox: J2000		V=24+/-1 Sloan-i = 15 +/- .5	Reference Frame: ICRS

Comments: We have mapped the relative path of Luhman 16AB between 2014 and 2016
Category=STAR
Description=[BROWN DWARF]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(7) LUHMAN16AB-RICCIOLO-1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG -4,4		60 Secs (60 Secs) *[==>]*	 ***[1]***
2		(7) LUHMAN16AB-RICCIOLO-1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG -4,4; SPATIAL SCAN 0.0 12,270.0 Degrees,Forward,0.45 Arcsec,6		380 Secs (380 Secs) *[==>]*	 ***[1]***
3		(7) LUHMAN16AB-RICCIOLO-1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG -4,-4; SPATIAL SCAN 0.0 12,0.0 Degrees,Forward,0.45 Arcsec,6		380 Secs (380 Secs) *[==>]*	 ***[1]***
4		(7) LUHMAN16AB-RICCIOLO-1	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=12	POS TARG 0,0		348 Secs (348 Secs) *[==>]*	 ***[1]***
5		(7) LUHMAN16AB-RICCIOLO-1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG 4,4; SPATIAL SCAN 0.0 12,180.0 Degrees,Forward,0.45 Arcsec,6		380 Secs (380 Secs) *[==>]*	 ***[1]***
6		(7) LUHMAN16AB-RICCIOLO-1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG 4,-4; SPATIAL SCAN 0.0 12,90.0 Degrees,Forward,0.45 Arcsec,6		380 Secs (380 Secs) *[==>]*	 ***[1]***
7		(7) LUHMAN16AB-RICCIOLO-1	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=12	POS TARG 4,-4		60 Secs (60 Secs) *[==>]*	 ***[1]***


Orbit Structure
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GS Acq
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Overhead
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
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Overhead
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Exp. 7
Overhead
Unused Orbital Visibility = 109
Occultation
Exp. 2
Setup
Exp. 3
Setup
Setup
Exp. 5
Exp. 6
Setup
0
500
1000
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2000
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3500
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