12985 - Determining the Mass of Proxima Centauri through Astrometric Microlensing

Cycle: 20, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Kailash C. Sahu (PI) (Contact)	**Space Telescope Science Institute**	**ksahu@stsci.edu**
Dr. Howard E. Bond (CoI)	Space Telescope Science Institute	bond@stsci.edu
Dr. Jay Anderson (CoI)	Space Telescope Science Institute	jayander@stsci.edu
Dr. Martin Dominik (CoI) (ESA Member)	University of St. Andrews	md35@st-andrews.ac.uk

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS	1	13-Nov-2012 21:28:47.0	yes
02	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS	1	13-Nov-2012 21:29:01.0	yes

2 Total Orbits Used

ABSTRACT

We propose to determine the mass of our nearest neighbor, Proxima Centauri, using the novel technique of astrometric microlensing. Proxima is a dM6e star, with an estimated mass of about 0.12 Msun, lying at a distance of 1.3 pc and having a large proper motion of 3.8 arcsec/yr. In a reprise of the famous 1919 solar eclipse that verified general relativity, Proxima will pass in front of a pair of 18th-magnitude background stars in 2015, affording us two independent opportunities to measure the relativistic deflection. The first passage will occur in May 2015 (impact parameter 1.5 arcsec), and the second in June 2015 (impact parameter 1.4 arcsec). As Proxima passes in front, it will cause a relativistic deflection of the background stars' images by ~0.5 milliarcsec, an amount readily detectable with HST/WFC3.

The gravitational deflection angle depends only upon the distances and relative positions of the stars, and the mass of the lens (Proxima). Since the distance to Proxima is well known from accurate parallax measurements, and the relative stellar positions can be determined precisely before the event, the astrometric measurement offers a unique and direct method to measure the mass of a single, isolated star. We anticipate better than 10% accuracy for the mass determination. The mass of Proxima is of special interest because it is the nearest M dwarf, representing the most common type of star in the Galaxy, for which the mass-luminosity relation is still uncertain at present.

OBSERVING DESCRIPTION

The first epoch observations will be taken in a few different filters (F475W, F555W, F606W, F814W) to better characterize the spectral type of the source. Subsequent observations will be taken mainly in 2 filters (F606W and F814W). We will obtain one short (0.5 sec) exposure to get an unsaturated image of Proxima, in order to register its position. The other exposures will be of 90 to 200 sec durations, so that the source stars will have a S/N & 300 in each exposure. We can obtain about 10 such exposures in each orbit, at 2 dither positions, which would be adequate to achieve the astrometric accuracy required for the project.

Visit

Proposal 12985, Visit 01, completed Wed Nov 14 02:29:09 GMT 2012

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 140.0D TO 152.0 D; BETWEEN 25-AUG-2012 AND 15-OCT-2012

Diagnostics

(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

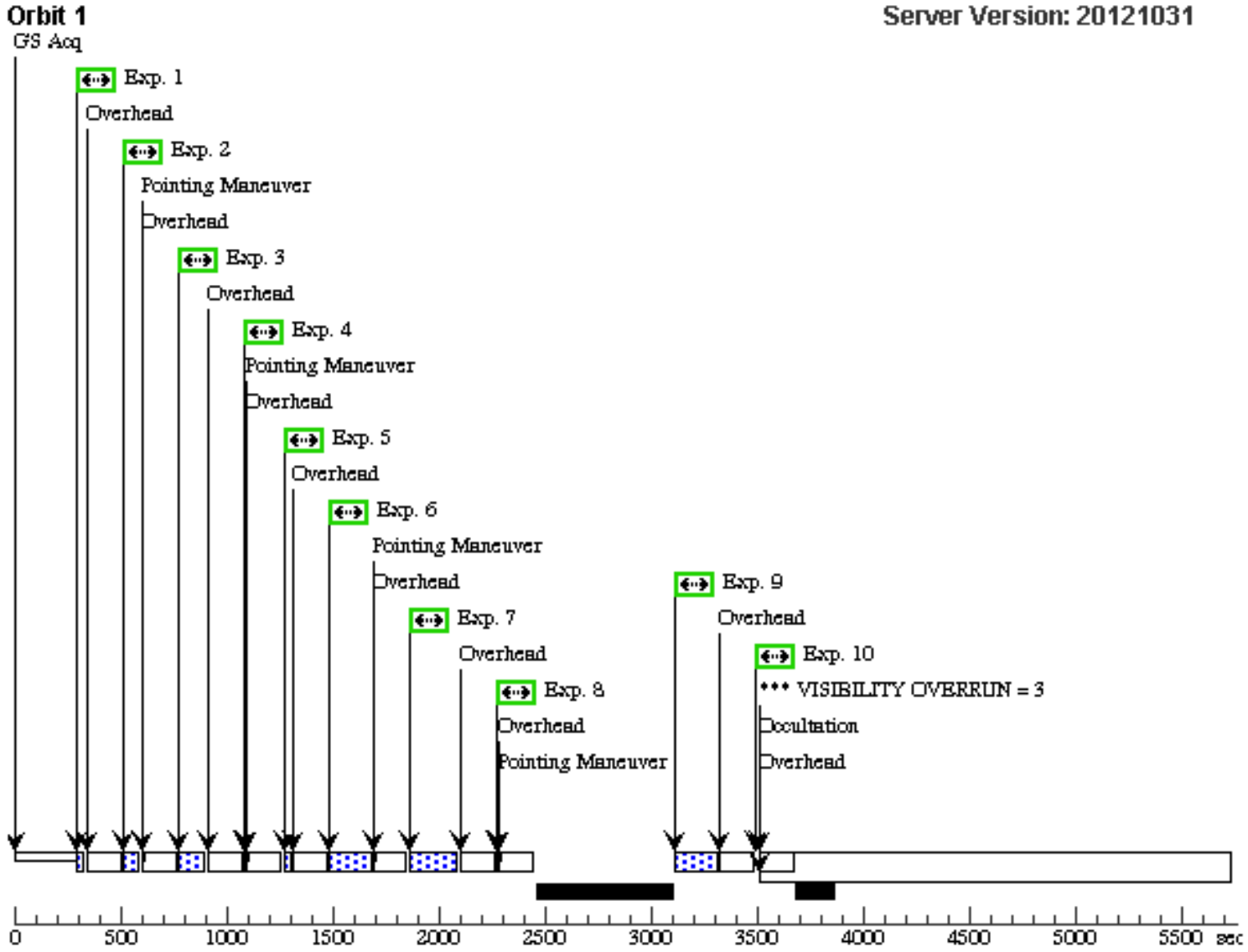
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PROXIMA-CEN-SOURCE	RA: 14 29 34.3300 (217.3930417d) Dec: -62 40 33.98 (-62.67611d) Equinox: J2000		V=18.4+/-0.2	Reference Frame: ICRS

Comments: This object was updated to the SOURCE that Proxima-Cen is going to lens. At present, the source and proxima-cen are separated by about 10.5 arcsec, and this separation will slowly decrease to 1.5 arcsec in 2015.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=12	POS TARG 10.4,9		0.5 Secs *[==>]*	***[1]***
2		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=10	SAME POS AS 1		70 Secs *[==>]*	***[1]***
3		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=8	POS TARG 14.35,9		100 Secs *[==>]*	***[1]***
4		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=12	POS TARG 14.35,9		0.5 Secs *[==>]*	***[1]***
5		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 10.39,12.95		0.5 Secs *[==>]*	***[1]***
6		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=5	SAME POS AS 5		200 Secs *[==>]*	***[1]***
7		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F475W	FLASH=8	POS TARG 6.45,8.98		200 Secs *[==>]*	***[1]***
8		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F475W	FLASH=12	POS TARG 6.45,8.98		0.5 Secs *[==>]*	***[1]***
9		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=6	POS TARG 10.43,5.05		175 Secs *[==>]*	***[1]***
10		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 10.43,5.05		0.5 Secs *[==>]*	***[1]***

Orbit Structure



Visit

Proposal 12985, Visit 02, implementation Wed Nov 14 02:29:11 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 326.12D TO 326.12 D; BETWEEN 25-MAR-2013 AND 01-APR-2013

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PROXIMA-CEN-SOURCE	RA: 14 29 34.3300 (217.3930417d) Dec: -62 40 33.98 (-62.67611d) Equinox: J2000		V=18.4+/-0.2	Reference Frame: ICRS

Comments: This object was updated to the SOURCE that Proxima-Cen is going to lens. At present, the source and proxima-cen are separated by about 10.5 arcsec, and this separation will slowly decrease to 1.5 arcsec in 2015.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=12	POS TARG 10.4,9		0.5 Secs *[==>]*	 ***[1]***
2		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=10	SAME POS AS 1		70 Secs *[==>]*	 ***[1]***
3		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=8	POS TARG 14.35,9		100 Secs *[==>]*	 ***[1]***
4		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=12	POS TARG 14.35,9		0.5 Secs *[==>]*	 ***[1]***
5		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 10.39,12.95		0.5 Secs *[==>]*	 ***[1]***
6		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=5	SAME POS AS 5		200 Secs *[==>]*	 ***[1]***
7		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F475W	FLASH=8	POS TARG 6.45,8.98		200 Secs *[==>]*	 ***[1]***
8		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F475W	FLASH=12	POS TARG 6.45,8.98		0.5 Secs *[==>]*	 ***[1]***
9		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	POS TARG 10.43,5.05		150 Secs *[==>]*	 ***[1]***
10		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 10.43,5.05		0.5 Secs *[==>]*	 ***[1]***

Orbit Structure