



# 13466 - Determining the Mass of Proxima Centauri through Astrometric Microlensing

Cycle: 21, Proposal Category: GO  
(Availability Mode: AVAILABLE)

## 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) PROXIMA-CEN-SOURCE	WFC3/UVIS	1	24-Mar-2014 22:21:44.0	yes
03	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS	1	24-Mar-2014 22:22:00.0	yes
02	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS	1	24-Mar-2014 22:22:12.0	yes

3 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  $\sim 0.5$  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.

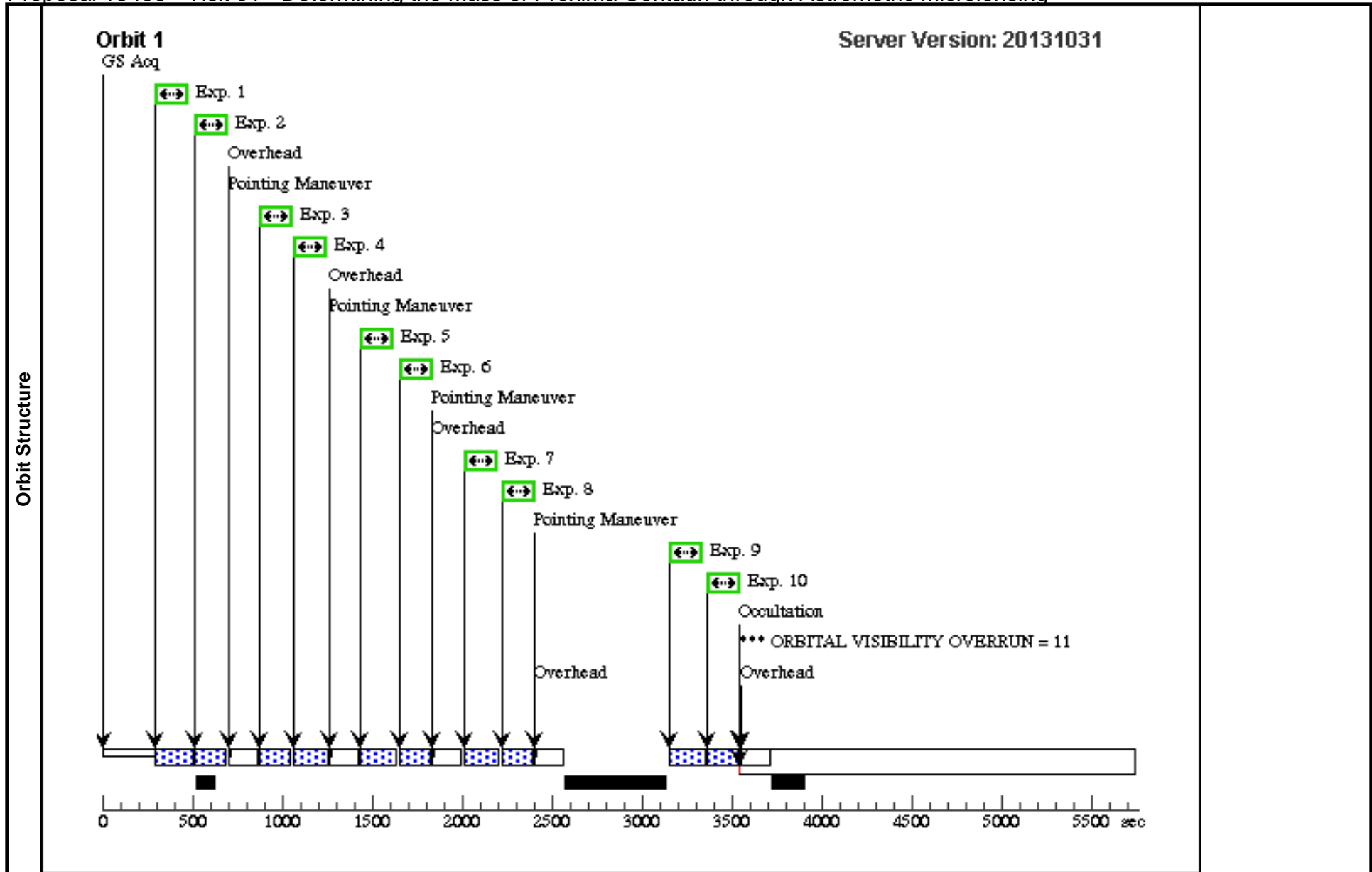
### **OBSERVING DESCRIPTION**

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  $\geq 300$  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.

Proposal 13466 - Visit 01 - Determining the Mass of Proxima Centauri through Astrometric Microlensing

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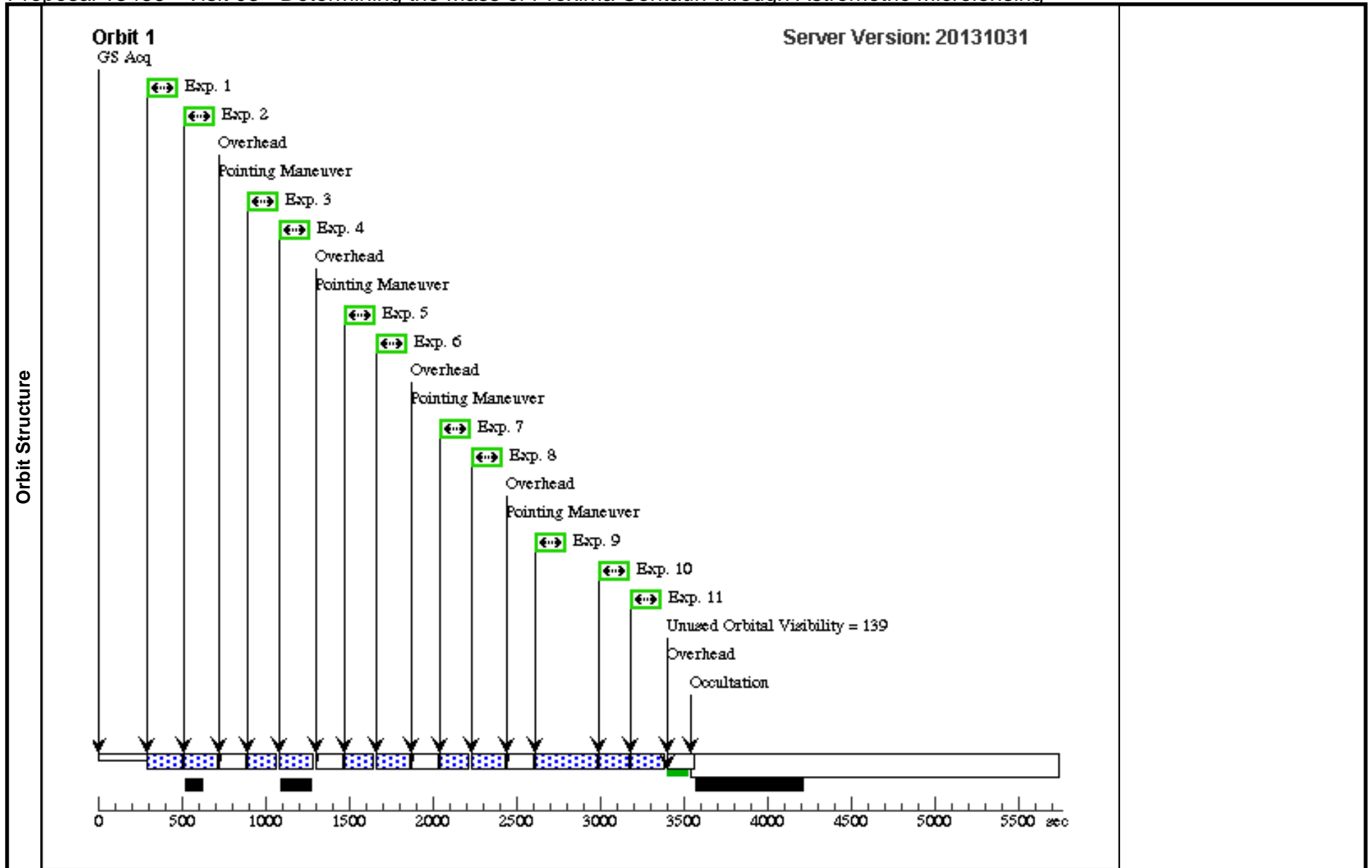
<b>Visit</b>	Proposal 13466, Visit 01, scheduled Diagnostic Status: Warning Scientific Instruments: WFC3/UVIS Special Requirements: ORIENT 326.12D TO 326.12 D; BETWEEN 25-MAR-2014 AND 15-APR-2014; VISIBILITY INTERVAL 59 M									
	(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN									
<b>Fixed Targets</b>	#	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.										
<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	BLADE=A; FLASH=12	POS TARG 10,4,9	Sequence 1-10 Non-Int in Visit 01	0.5 Secs (0.5 Secs) [==>]	[1]
	2	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 1	Sequence 1-10 Non-Int in Visit 01	170 Secs (170 Secs) [==>]	[1]
	3	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 15,10	Sequence 1-10 Non-Int in Visit 01	0.5 Secs (0.5 Secs) [==>]	[1]
	4	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=8	SAME POS AS 3	Sequence 1-10 Non-Int in Visit 01	170 Secs (170 Secs) [==>]	[1]
	5	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 10,4,13,0	Sequence 1-10 Non-Int in Visit 01	0.5 Secs (0.5 Secs) [==>]	[1]
	6	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 5	Sequence 1-10 Non-Int in Visit 01	170 Secs (170 Secs) [==>]	[1]
	7	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=12	POS TARG 10,4,5	Sequence 1-10 Non-Int in Visit 01	0.5 Secs (0.5 Secs) [==>]	[1]
	8	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=8	SAME POS AS 7	Sequence 1-10 Non-Int in Visit 01	170 Secs (170 Secs) [==>]	[1]
	9	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 5,4,9	Sequence 1-10 Non-Int in Visit 01	0.5 Secs (0.5 Secs) [==>]	[1]
10	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 9	Sequence 1-10 Non-Int in Visit 01	170 Secs (170 Secs) [==>]	[1]	



Proposal 13466 - Visit 03 - Determining the Mass of Proxima Centauri through Astrometric Microlensing

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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			
<i>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.</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	BLADE=A; FLASH=12	POS TARG 10.4,9	Sequence 1-11 Non-Int in Visit 03	0.5 Secs (0.5 Secs) [==>]	[1]
	2		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 1	Sequence 1-11 Non-Int in Visit 03	200 Secs (200 Secs) [==>]	[1]
	3		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 15,10	Sequence 1-11 Non-Int in Visit 03	0.5 Secs (0.5 Secs) [==>]	[1]
	4		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 3	Sequence 1-11 Non-Int in Visit 03	200 Secs (200 Secs) [==>]	[1]
	5		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 10.4,13.0	Sequence 1-11 Non-Int in Visit 03	0.5 Secs (0.5 Secs) [==>]	[1]
	6		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 5	Sequence 1-11 Non-Int in Visit 03	200 Secs (200 Secs) [==>]	[1]
	7		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 10.4,5	Sequence 1-11 Non-Int in Visit 03	0.5 Secs (0.5 Secs) [==>]	[1]
	8		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 7	Sequence 1-11 Non-Int in Visit 03	200 Secs (200 Secs) [==>]	[1]
	9		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 10	Sequence 1-11 Non-Int in Visit 03	200 Secs (200 Secs) [==>]	[1]
	10		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12; BLADE=A	POS TARG 5.4,9	Sequence 1-11 Non-Int in Visit 03	0.5 Secs (0.5 Secs) [==>]	[1]
	11		(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 10	Sequence 1-11 Non-Int in Visit 03	200 Secs (200 Secs) [==>]	[1]



Proposal 13466 - Visit 02 - Determining the Mass of Proxima Centauri through Astrometric Microlensing

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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			
<i>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.</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12; BLADE=A	POS TARG 14.4,9	Sequence 1-10 Non-Int in Visit 02	0.5 Secs (0.5 Secs) [==>]	[1]
	2	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	POS TARG 14.4,9	Sequence 1-10 Non-Int in Visit 02	200 Secs (200 Secs) [==>]	[1]
	3	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 10.4,13.0	Sequence 1-10 Non-Int in Visit 02	0.5 Secs (0.5 Secs) [==>]	[1]
	4	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 3	Sequence 1-10 Non-Int in Visit 02	200 Secs (200 Secs) [==>]	[1]
	5	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12	POS TARG 10.4,5	Sequence 1-10 Non-Int in Visit 02	0.5 Secs (0.5 Secs) [==>]	[1]
	6	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 5	Sequence 1-10 Non-Int in Visit 02	200 Secs (200 Secs) [==>]	[1]
	7	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 8	Sequence 1-10 Non-Int in Visit 02	200 Secs (200 Secs) [==>]	[1]
	8	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12; BLADE=A	POS TARG 4.0,9	Sequence 1-10 Non-Int in Visit 02	0.5 Secs (0.5 Secs) [==>]	[1]
	9	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=8	SAME POS AS 8	Sequence 1-10 Non-Int in Visit 02	200 Secs (200 Secs) [==>]	[1]
10	(1) PROXIMA-CEN-SOURCE	(1) PROXIMA-CEN-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F555W	FLASH=12; BLADE=A	SAME POS AS 8	Sequence 1-10 Non-Int in Visit 02	0.5 Secs (0.5 Secs) [==>]	[1]	

