14337 - Dynamical Masses for Free-Floating Planetary-Mass Binaries

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?*
01	(1) 2MASSWJ0103320+193536	ACS/WFC	1	21-Jul-2015 22:28:16.0	yes
02	(1) 2MASSWJ0103320+193536	ACS/WFC	1	21-Jul-2015 22:28:17.0	yes
03	(2) WISEJ014656.66+423410.0	ACS/WFC	1	21-Jul-2015 22:28:18.0	yes
04	(2) WISEJ014656.66+423410.0	ACS/WFC	1	21-Jul-2015 22:28:19.0	yes
05	(4) WISEPJ234446.25+103415.8	ACS/WFC	1	21-Jul-2015 22:28:20.0	yes
06	(4) WISEPJ234446.25+103415.8	ACS/WFC	1	21-Jul-2015 22:28:20.0	yes

6 Total Orbits Used

ABSTRACT

We propose a 3-year orbit monitoring program to measure the first dynamical masses in the planetary-mass regime (5-15 Mjup) for free-floating objects, including the first known Y dwarf binary. With projected separations of only 0.7-1.4 AU, our targets are among the tightest substellar visual

binaries ever found and are amenable to orbit determinations within only a few years. When combined with our parallax determination, these data will yield dynamical masses with <10% uncertainties. Two of our targets are late-T/Y dwarf field binaries (ages ~ 1-5 Gyr) and will provide the first empirical calibration in the poorly understood temperature regime of ~350-500 K, relevant both to free-floating objects and radial-velocity exoplanets. Such extreme conditions are the frontier of current theory, e.g. model uncertainties in non-equilibrium chemistry, metallicity, and clouds yield mass estimates that currently span an order of magnitude. Our third target is a young field L dwarf (age ~ 10-100 Myr), one of the rare field objects that that serve as analogs for young directly imaged exoplanets. Our dynamical mass combined with evolutionary models will yield the first precise age and temperature estimates for such an object, thereby testing our ability to derive physical parameters from current models. Our targets have been discovered at the limits of existing facilities and thus promise to be the only viable objects in the planetary-mass regime for direct mass measurements until next-generation facilities like JWST come online.

OBSERVING DESCRIPTION

The goal of our observations is to obtain precise relative astrometry (~3--5 mas) for three free-floating, planetary-mass binaries. Our data spanning 3 cycles will allow us to determine their orbits and thereby measure their dynamical masses. ACS/WFC enables a finer pixel scale than WFC3/IR and better sensitivity than WFC3/UVIS, both of which (high SNR, and better deblending of our tight <~0.1" binaries) are key to achieving our science goals.

We use a standard 3-position dither sequence to guard against cosmic rays and to sample different parts of the detector in case our target lands on a bad pixel in a single pointing. We set the exposure times to fill the time available in each visit, which will yield SNR of ~30--40 for our two fainter WISE sources and will not saturate the brighter 2MASS source.

Visit

Proposal 14337, 2MASS0103+1935_EP01 (01), implementation Wed Jul 22 02:28:21 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: BETWEEN 03-NOV-2015:00:00:00 AND 14-NOV-2015:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

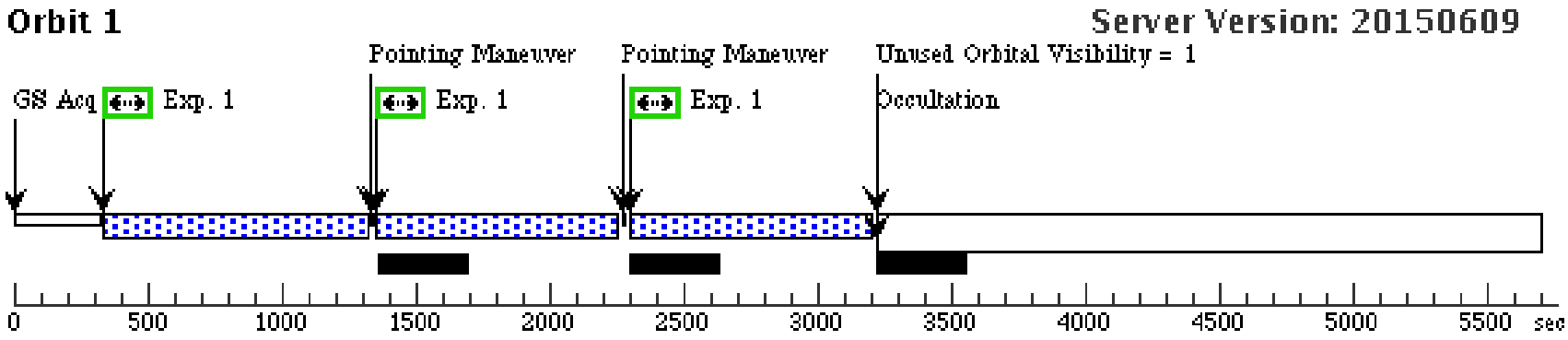
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	2MASSWJ0103320+193536	RA: 01 03 32.3559 (15.8848162d) Dec: +19 35 36.23 (19.59340d) Equinox: J2000	Proper Motion RA: 301.7 mas/yr Proper Motion Dec: 20.4 mas/yr Epoch of Position: 2012.57	V=(?) J=16.3 mag	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2MASSWJ0103320+193536	ACS/WFC, ACCUM, WFC1-CTE	F850LP			Pattern 1, Exps 1-1 in 2MASS0103+1935_EP01 (01) (1)	750 Secs (2343 Secs) *[==>781.0 Secs (Pattern 1)]* *[==>781.0 Secs (Pattern 2)]* *[==>781.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 14337, 2MASS0103+1935_EP02 (02), implementation Wed Jul 22 02:28:21 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: BETWEEN 30-JUN-2016:00:00:00 AND 19-JUL-2016:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

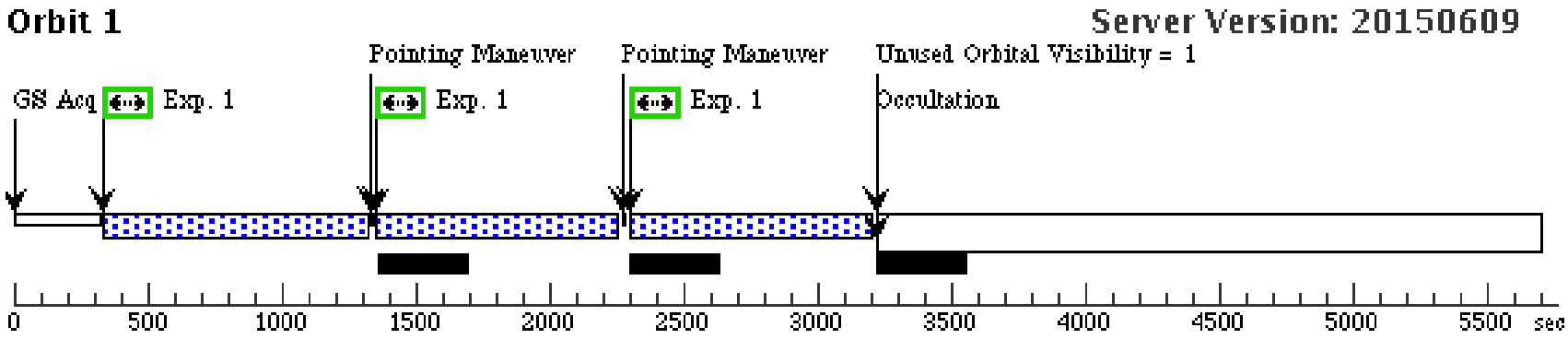
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	2MASSWJ0103320+193536	RA: 01 03 32.3559 (15.8848162d) Dec: +19 35 36.23 (19.59340d) Equinox: J2000	Proper Motion RA: 301.7 mas/yr Proper Motion Dec: 20.4 mas/yr Epoch of Position: 2012.57	V=(?) J=16.3 mag	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) 2MASSWJ0103320+193536	ACS/WFC, ACCUM, WFC1-CTE	F850LP			Pattern 1, Exps 1-1 in 2MASS0103+1935_EP02 (02) (1)	750 Secs (2343 Secs) *[==>781.0 Secs (Pattern 1)]* *[==>781.0 Secs (Pattern 2)]* *[==>781.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 14337, WISE0146+4234_EP01 (03), implementation Wed Jul 22 02:28:22 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: BETWEEN 16-NOV-2015:00:00:00 AND 29-NOV-2015:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false		(1)

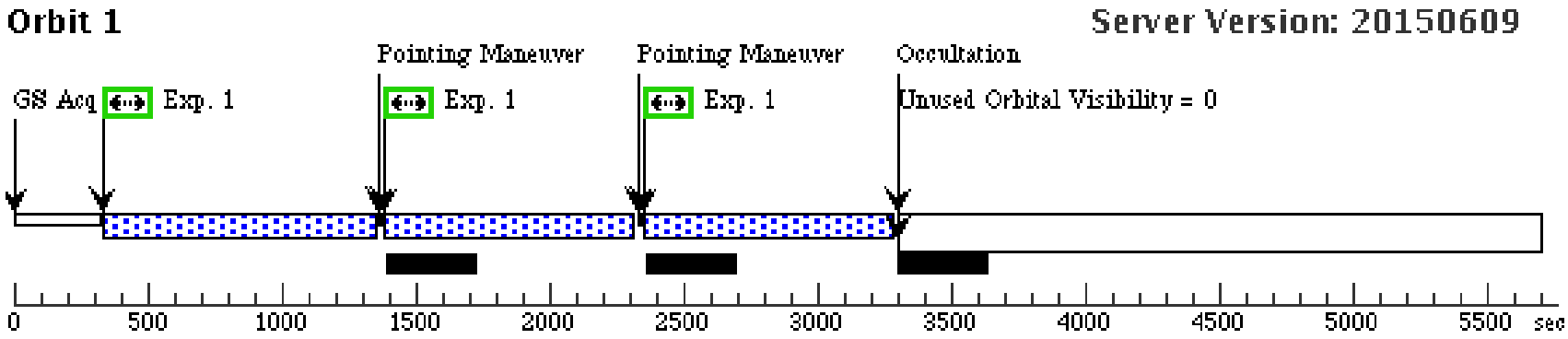
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	WISEJ014656.66+423410.0	RA: 01 46 56.6675 (26.7361146d) Dec: +42 34 10.05 (42.56946d) Equinox: J2000	Proper Motion RA: -440 mas/yr Proper Motion Dec: -30 mas/yr Epoch of Position: 2010.07	V=(?) J=20.7 mag	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) WISEJ014656.66+423410.0	ACS/WFC, ACCUM, WFC1-CTE	F850LP			Pattern 1, Exps 1-1 in WISE0146+4234_EP01 (03) (1)	800 Secs (2430 Secs) *[==>810.0 Secs (Pattern 1)]* *[==>810.0 Secs (Pattern 2)]* *[==>810.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 14337, WISE0146+4234_EP02 (04), implementation Wed Jul 22 02:28:22 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: BETWEEN 02-JUL-2016:00:00:00 AND 18-JUL-2016:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false		(1)

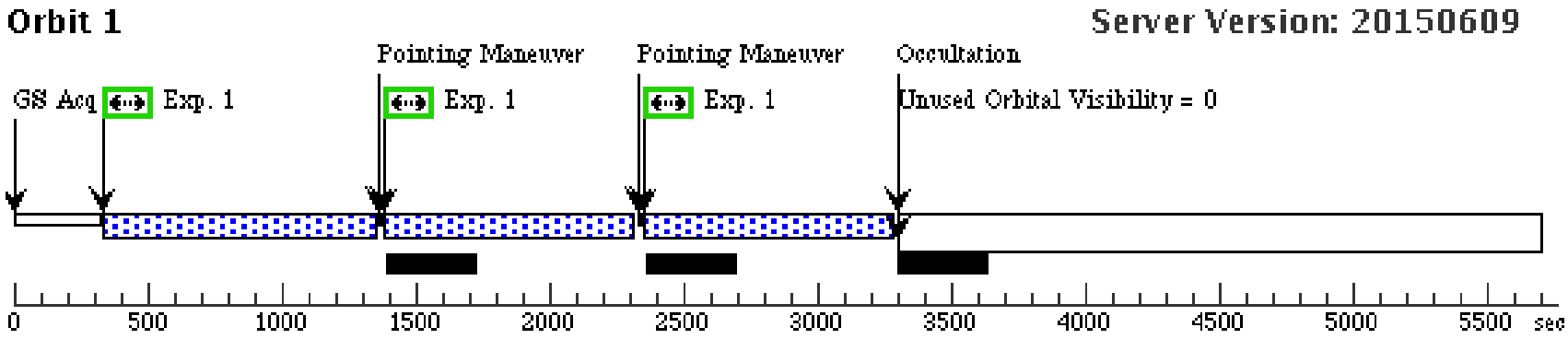
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	WISEJ014656.66+423410.0	RA: 01 46 56.6675 (26.7361146d) Dec: +42 34 10.05 (42.56946d) Equinox: J2000	Proper Motion RA: -440 mas/yr Proper Motion Dec: -30 mas/yr Epoch of Position: 2010.07	V=(?) J=20.7 mag	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) WISEJ014656.66+423410.0	ACS/WFC, ACCUM, WFC1-CTE	F850LP			Pattern 1, Exps 1-1 in WISE0146+4234_EP02 (04) (1)	800 Secs (2430 Secs) *[==>810.0 Secs (Pattern 1)]* *[==>810.0 Secs (Pattern 2)]* *[==>810.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 14337, WISE2344+1034_EP01 (05), implementation Wed Jul 22 02:28:22 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: BETWEEN 06-OCT-2015:00:00:00 AND 30-OCT-2015:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false		(1)

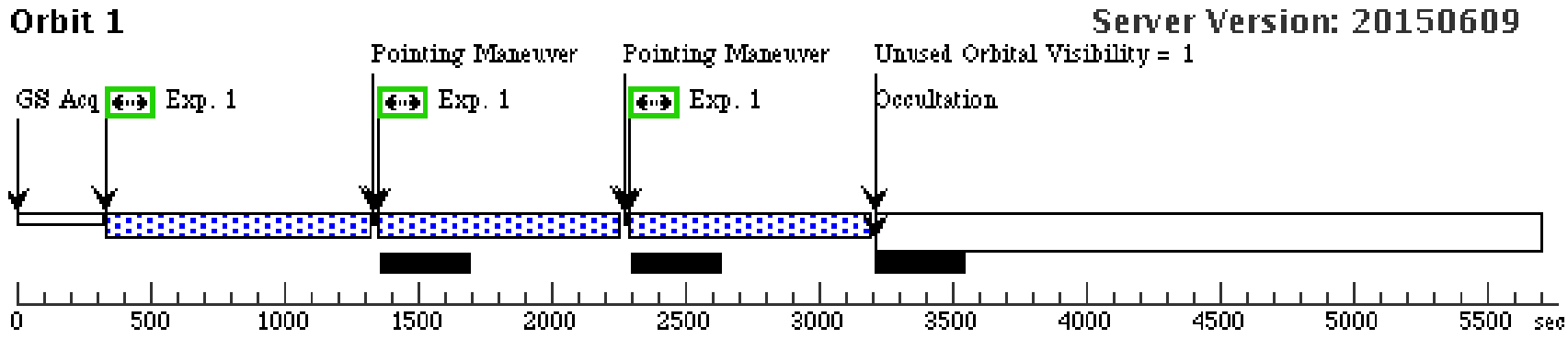
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	WISEPJ234446.25+103415.8	RA: 23 44 46.5300 (356.1938750d) Dec: +10 34 15.20 (10.57089d) Equinox: J2000	Proper Motion RA: 860 mas/yr Proper Motion Dec: -10 mas/yr Epoch of Position: 2014.80	V=(?) J=18.8 mag	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(4) WISEPJ234446.25+103415.8	ACS/WFC, ACCUM, WFC1-CTE	F850LP			Pattern 1, Exps 1-1 in WISE2344+1034_EP01 (05) (1)	700 Secs (2340 Secs) *[==>780.0 Secs (Pattern 1)]* *[==>780.0 Secs (Pattern 2)]* *[==>780.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 14337, WISE2344+1034_EP02 (06), implementation Wed Jul 22 02:28:22 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: BETWEEN 13-MAY-2016:00:00:00 AND 25-MAY-2016:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=3.011 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	WISEPJ234446.25+103415.8	RA: 23 44 46.5300 (356.1938750d) Dec: +10 34 15.20 (10.57089d) Equinox: J2000	Proper Motion RA: 860 mas/yr Proper Motion Dec: -10 mas/yr Epoch of Position: 2014.80	V=(?) J=18.8 mag	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(4) WISEPJ234446.25+103415.8	ACS/WFC, ACCUM, WFC1-CTE	F850LP			Pattern 1, Exps 1-1 in WISE2344+1034_EP02 (06) (1)	700 Secs (2340 Secs) *[==>780.0 Secs (Pattern 1)]* *[==>780.0 Secs (Pattern 2)]* *[==>780.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure