11290 - Dynamical Masses and Third Bodies in the Sirius System

Cycle: 16, 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) SIRIUS	WFPC2	1	21-May-2007 17:26:46.0	yes

1 Total Orbits Used

ABSTRACT

Sirius B is the nearest and brightest of all white dwarfs (WDs), but it is fiendishly difficult to observe from the ground because of the overwhelming brightness of Sirius A. We propose a continuation of our program of imaging observations of the Sirius system with WFPC2, which has been underway since 2001. The resulting astrometric data will not only greatly improve the precision of the binary orbit and the dynamical mass measurements for both the main-sequence and WD components, but will also test definitively for the claimed presence of a third body in this famous

system, down to planetary masses. At present, there is a tantalizing suggestion in our data that there indeed may exist a substellar or planetary third body in the system.

Our team has also obtained superb spectra of Sirius B using STIS, and we have achieved an excellent fit to the spectrum using model stellar atmospheres. However, the implied mass of the WD disagrees significantly with the dynamical mass implied by the existing visual-binary orbit (which still has to be based on a combination of low-accuracy ground-based astrometry plus the small number of existing HST astrometric observations). This is another critical motivation for improving the astrometry.

OBSERVING DESCRIPTION

Our team has been making regular (semi-annual) observations of the separation and position angle of the Sirius system since 2001.

In order to refine the visual orbit of Sirius and the implied dynamical masses of both stars, and to search for perturbations due to third bodies down to planetary mass, we propose to continue this program during Cycles~14, 15, and~16.

Based on Fig.~2, it does not appear that there are significant perturbations on a timescale of less than about a year. We therefore propose to observe with WFPC2 once a year. We will continue to use the F1042M filter, which suppresses the light of Sirius~A to the extent that its image can be centroided using the diffraction spikes (this was done by Schroeder et~al.\ 2000, and we have found that it works well). The short exposures for Sirius~A will be alternated with longer exposures for Sirius~B at the same telescope pointing, with the process repeated at several different dither positions (a technique Bond is also using

successfully in his ongoing companion program on Procyon). The photocenter motion of Sirius~A is well known from the ground, so we do not need to request any FGS observations (fortunately, since it is too bright anyway!). Total request: 1 WFPC2 orbit each in Cycles 14, 15, and 16.

We prefer to use WFPC2 as long as it is available, for continuity of the program. However, it would be feasible to switch to ACS/HRC if necessary, or of course to WFC3 when it is installed.

Visit

Proposal 11290, Visit 01, implementation Mon May 21 21:26:51 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: PCS MODE FINE; SCHED 90%; ORIENT 249.0D TO 282.2 D; ORIENT 289.8D TO 12.2 D; ORIENT 22.8D TO 56.0 D; BETWEEN 25-DEC-2007:00:00:00 AND 15-MAY-2008:00:00:00

Comments: ORIENT requirement is done so that companion star will not lie near diffraction spikes or bleeding columns from the very bright primary star.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SIRIUS	RA: 06 45 9.2500 (101.2885417d) Dec: -16 42 48.50 (-16.71347d) Equinox: J2000	Proper Motion RA: -0.038011s/yr Proper Motion Dec: -1.22308"/yr Parallax: 0.379" Epoch of Position: 1991.25	V=-1.47	Reference Frame: HIPPARCOS/TYCHO_CATALOGUE

Comments: Coordinates from Hipparcos Catalog. However, we actually list a position 1.5 arcsec south of the Hipparcos position, in order to point at the center of mass of the binary.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	POS TARG 0,0		8.0 Secs *[==>]*	***[1]***
2		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	SAME POS AS 1		60.0 Secs *[==>]*	***[1]***
3		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	POS TARG -0.661,-0.661		8.0 Secs *[==>]*	***[1]***
4		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	SAME POS AS 3		60.0 Secs *[==>]*	***[1]***
5		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	POS TARG -0.422,-0.376		8.0 Secs *[==>]*	***[1]***
6		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	SAME POS AS 5		60.0 Secs *[==>]*	***[1]***
7		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	POS TARG -0.319,-0.479		8.0 Secs *[==>]*	***[1]***
8		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	SAME POS AS 7		60.0 Secs X 2 *[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***
9		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	POS TARG -0.57,-0.273		8.0 Secs *[==>]*	***[1]***
10		(1) SIRIUS	WFPC2, IMAGE, PC1	F1042M	ATD-GAIN=15; CLOCKS=YES	SAME POS AS 9		60.0 Secs X 2 *[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***

Orbit Structure