10990 - Dynamical Masses and Third Bodies in the Sirius System

Cycle: 15, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Howard E. Bond (PI)	**Space Telescope Science Institute**	**bond@stsci.edu**
Dr. Martin Barstow (CoI) (ESA Member)	University of Leicester	mab@star.le.ac.uk
Dr. Matthew Burleigh (CoI) (ESA Member)	University of Leicester	mbu@star.le.ac.uk
Dr. Jay B. Holberg (CoI)	University of Arizona	holberg@argus.lpl.arizona.edu
Dr. Edmund Nelan (CoI)	Space Telescope Science Institute	nelan@stsci.edu
Dr. Gail Schaefer (CoI)	Space Telescope Science Institute	gschaefer@stsci.edu

VISITS

Visit	*Targets*	*Configurations*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) SIRIUS	WFPC2	1	07-Jun-2006 21:02:35.0	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.

We will continue to use dither WFPC2 imaging in a filter that reduces the overexposure of Sirius A.

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 10990, Visit 01 Thu Jun 08 01:02:39 GMT 2006

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: PCS MODE FINE; ORIENT 244.0D TO 277.2 D; ORIENT 284.8D TO 7.2 D; ORIENT 14.8D TO 48.0 D; BETWEEN 25-DEC-2006:00:00:00 AND 15-MAY-2007:00:00:00

Comments: ORIENT requirement is done so that companion star will not lie near diffraction spikes or bleeding columns from the very bright primary star. ORIENT was updated on Jun 6, 2006, based on measurements of frames taken January 2006.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SIRIUS	RA: 06 45 9.3000 (101.2887500d) Dec: -16 42 48.60 (-16.71350d) 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: ICRS

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. June 6, 2006: position updated to ICRS system, using galex conversion tool. Old and new coordinates are: GSC-I 06:45: 9.25 -16:42:48.5 GSC-II/ICRS 06:45: 9.30 -16:42:48.6

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 X 2 *[==>(Copy 1)]* *[==>(Copy 2)]*	 ***[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 *[==>40.0 Secs (Copy 1)]* *[==>(Copy 2)]*	 ***[1]***

Orbit Structure