13850 - Accurate Mass Determination of the Nearby Old White Dwarf Stein 2051B through Astrometric Microlensing

Cycle: 22, Proposal Category: GO

(Availability Mode: AVAILABLE)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Kailash C. Sahu (PI) (Contact)	**Space Telescope Science Institute**	**ksahu@stsci.edu**
Dr. Howard E. Bond (CoI)	The Pennsylvania State University	heb11@psu.edu
Dr. Jay Anderson (CoI)	Space Telescope Science Institute	jayander@stsci.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) STEIN-2051B-SOURCE	WFC3/UVIS	1	18-Sep-2014 21:04:50.0	yes

1 Total Orbits Used

ABSTRACT

The very nearby and well-known cool white dwarf (WD) Stein 2051B will pass very close to a 19.5-mag background star in March 2014, with an impact parameter of <0.2 arcsec. This affords a unique opportunity for a direct determination of its mass, through measurement of the gravitational deflection of the background star's image.

As it passes in front, Stein 2051B will cause a deflection of the background star's image by ~3 milliarcsec, an amount detectable at the ~10-sigma level with HST/WFC3. The gravitational deflection angle depends only on the distances and relative positions of the stars, and on the mass of the WD. Since the distances and positions can be determined precisely before the event, the astrometric measurement offers a unique and direct method to measure the mass of the WD to high accuracy (<5%).

One key astrophysical prediction for WDs is the existence of a mass-radius relation, which depends primarily on the core composition of the WD. Since the radius of Stein 2051B is known (from its distance, luminosity, and effective temperature), our mass measurement will provide an important addition to the very small number of WDs with well-determined radii and masses. The mass of Stein 2051B is of special interest because it is an old and relatively massive WD.

OBSERVING DESCRIPTION

We need to know accurate locations and proper motions for Stein 2051B and the source star, in order to predict the precise circumstances of the event, including the date and impact parameter. The existing ground-based measurements do not have the 1 mas accuracy needed for these purposes, especially given the 6.5 mas/day proper motion of Stein 2051B. Therefore, we will use direct imaging with WFC3 to determine the astrometric parameters of Stein 2051B, the source star, and the surrounding reference field. These determinations need to be done well in advance of the closest encounter in March 2014, beginning in Cycle 21.

The maximum deflection of the source position that is actually observable occurs just before the images of the two stars become blended (at HST resolution), which happens about 30 days before closest approach (and 30 days after closest approach). So, we need to know the time of closest approach as accurately as possible in order to schedule these two critical observations. Additional observations should be scheduled before and after those critical times, when the deflection is changing most rapidly with time.

Visit

Proposal 13850, Visit 01, scheduling Fri Sep 19 01:04:51 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 243D TO 243 D; BETWEEN 01-OCT-2014 AND 02-OCT-2014; VISIBILITY INTERVAL 54.8 M

Comments: ORIENT constraints are used to:
(i) avoid diffraction spikes and bleed columns from Stein 2051A and B falling near the faint source star, and
(ii) 0bserve at an orient which is close to (within 25 degrees of) visit 1 of HST program 13457

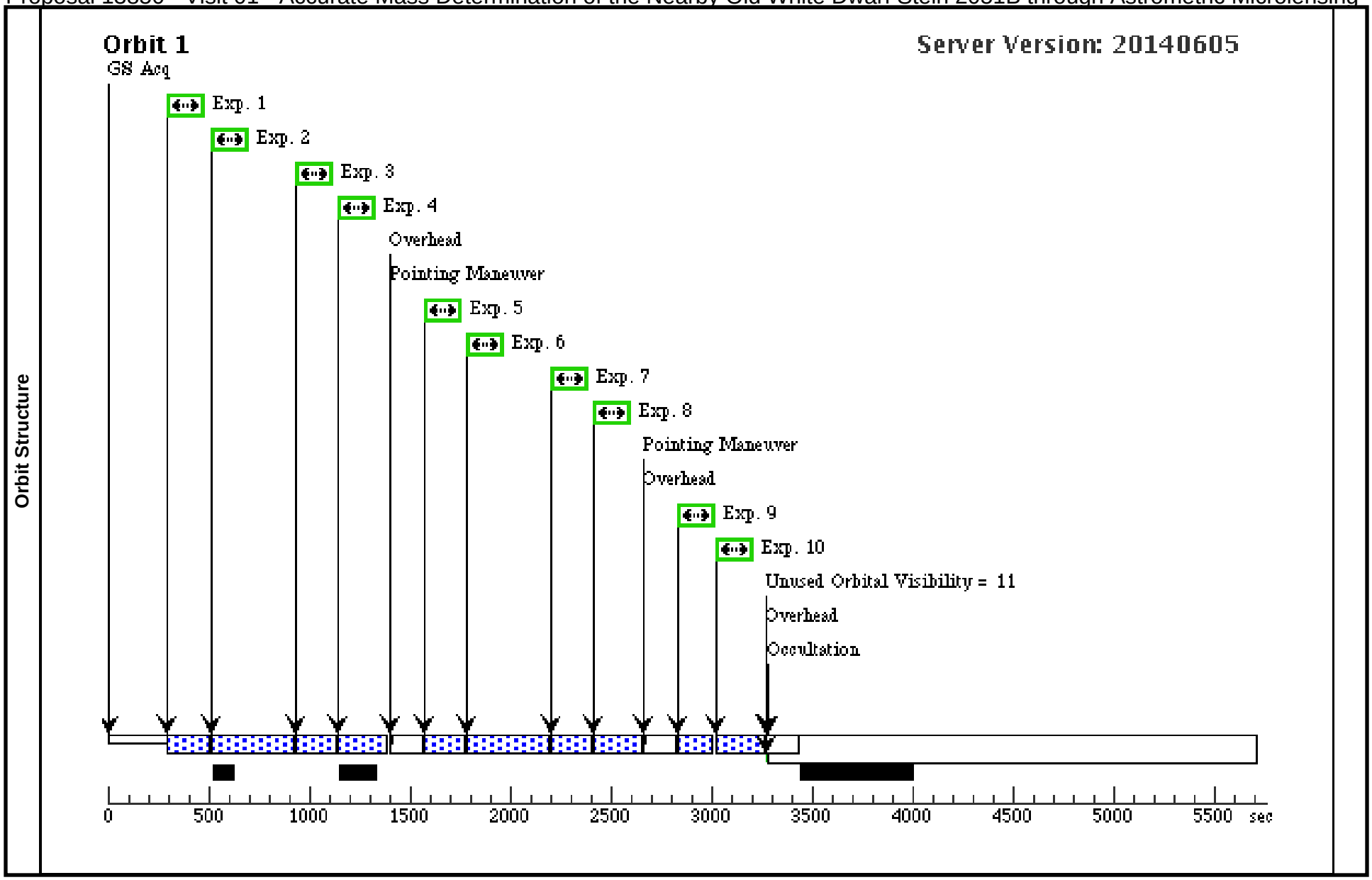
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	STEIN-2051B-SOURCE	RA: 04 31 15.0090 (67.8125375d) Dec: +58 58 13.17 (58.97032d) Equinox: J2000		V=12.45	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) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=12; BLADE=A	POS TARG 10.4,9	Sequence 1-10 Non-Int in Visit 01	0.5 Secs (0.5 Secs) *[==>]*	*[1]*
2		(1) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=1	SAME POS AS 1	Sequence 1-10 Non-Int in Visit 01	240 Secs (240 Secs) *[==>]*	*[1]*
3		(1) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=12	SAME POS AS 1	Sequence 1-10 Non-Int in Visit 01	1.0 Secs (1 Secs) *[==>]*	*[1]*
4		(1) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=6	SAME POS AS 1	Sequence 1-10 Non-Int in Visit 01	240 Secs (240 Secs) *[==>]*	*[1]*
5		(1) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=12	POS TARG 14.35,9	Sequence 1-10 Non-Int in Visit 01	0.5 Secs (0.5 Secs) *[==>]*	*[1]*
6		(1) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=1	SAME POS AS 5	Sequence 1-10 Non-Int in Visit 01	240 Secs (240 Secs) *[==>]*	*[1]*
7		(1) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=12	SAME POS AS 5	Sequence 1-10 Non-Int in Visit 01	1.0 Secs (1 Secs) *[==>]*	*[1]*
8		(1) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=6	SAME POS AS 5	Sequence 1-10 Non-Int in Visit 01	240 Secs (240 Secs) *[==>]*	*[1]*
9		(1) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=12	POS TARG 10.39,12.95	Sequence 1-10 Non-Int in Visit 01	1 Secs (1 Secs) *[==>]*	*[1]*
10		(1) STEIN-2051B-SOURCE	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=6	POS TARG 10.39,12.95	Sequence 1-10 Non-Int in Visit 01	240 Secs (240 Secs) *[==>]*	*[1]*


Orbit 1
Server Version: 20140605
Orbit Structure
GS Acq
Exp. 1
Exp. 2
Exp. 3
Exp. 4
Overhead
Pointing Maneuver
Exp. 5
Exp. 6
Exp. 7
Exp. 8
Pointing Maneuver
Overhead
Exp. 9
Exp. 10
Unused Orbital Visibility = 11
Overhead
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
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sec