11300 - Mass and Radius of a Near-Chandrasekhar-limit magnetic white dwarf

Cycle: 16, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Stefan Jordan (PI) (ESA Member)	**Astronomisches Rechen-Institut Heidelberg**	**jordan@ari.uni-heidelberg.de**
Dr. Ulrich Bastian (CoI) (ESA Member)	Astronomisches Rechen-Institut Heidelberg	bastian@ari.uni-heidelberg.de
Dr. Martin Altmann (CoI)	Departamento de Astronomie de la Universidad de Chile	martin@das.uchile.cl

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) RE-0317-853 (2) LB9802 (3) REF1 (4) REF2 (8) REF6 (9) REF7 (10) REF8 (11) REF9	FGS	1	18-Jan-2008 05:37:31.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
02	(1) RE-0317-853 (2) LB9802 (3) REF1 (4) REF2 (8) REF6 (9) REF7 (10) REF8 (11) REF9	FGS	1	18-Jan-2008 05:37:44.0	yes

2 Total Orbits Used

ABSTRACT

REJ0317-853 is a unique object. According to our analyses it is the most massive white dwarf ever found, with a mass of 1.35 solar masses, approaching the Chandrasekhar limit. With a period of just 725 seconds it is the most rapidly rotating isolated white dwarf ever found. Moreover, RE J0317-853 is the hottest magnetic white dwarf discovered so far and has a strong magnetic field varying from about 180 to more than 700 MG over the stellar surface. Due to its strong polarization and high mass it has been used to test gravitational theories predicting gravitational birefringence. However, the existing mass and radius determination is indirect and still uncertain and would greatly profit from a high-precision parallax determination with the HST FGS.

OBSERVING DESCRIPTION

We will obtain parallaxes of the unique magnetic white dwarf RE J0317-853 and its companion star, the non-magnetic DA white dwarf LB~09802, just 7 arcseconds away.

The best current distance estimation based on a spectroscopic parallax of LB~09802 is about 35 pc. The mass determination of RE J0317-853 is entirely based on this measurement with all uncertainties of the spectroscopic parallax particularly the log g determination of LB~09802.

Theoretically it is also possible although completely implausible that both stars are not physically associated.

At 35pc the distance between both components is about 600 au, far too large for common-envelope evolution.

The FGS measurements will allow us to measure the parallaxes of both stars with an uncertainty of about 1 mas ($\Delta \pi/\pi=3$\%). With the brightness of our two target stars of V=14.9 (RE J0317-853) and V=14.1 (LB~09802) we calculate that 6 orbits are necessary to achieve the final parallaxes. The observing scheme that we propose is the one suggested by the FGS handbook and used in practically all prior studies (e.g. Beuermann et al. 2004, A&A 419, 291; Beuermann et al. 2003, A&A 412, 821; McArthur et al. 1999, ApJ 520, L59; Harrison et al. 1999, ApJ 515, L93).

To obtain a parallax measurement, a field must generally be observed at least three times, at the seasons of maximum parallax factor. These seasons are separated by six months. In order to obtain a proper parallax solution which involves solving for six unknowns, three visits spanning two HST cycles are necessary, two each in cycle 15 at the seasons of maximum parallax factor of the individual source and one in cycle 16.

In the special case of RE J0317-853 and its companion (ecliptic latitude beta=62degrees, sin beta=0.88) the condition of maximum parallax factor is satisfied at all times, but still the second and third visits must be separated by about six and twelve months from the first one. Given the brightness of the targets, previous experience shows that two orbits per visit are required to achieve the targeted accuracy in the final parallaxes. Using the general approach of earlier observations, these orbits should preferably be scheduled a week apart. We will use the same reference stars for the two target white dwarfs, thus saving observation time and using no more HST orbits than would be necessary for a single parallax measurement. Using identical reference stars will make the parallax difference between the two putative companion stars more precise than their absolute parallaxes even.

Visit

Proposal 11300, Visit 01, implementation Fri Jan 18 10:37:49 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: FGS

Special Requirements: SCHED 70%; ORIENT 138.0D TO 138.0 D; BETWEEN 24-MAR-2008:00:00:00 AND 30-MAR-2008:00:00:00

Comments: Two Guide Star FineLock Required.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	RE-0317-853 Alt Name1: GSC2.010033026502	RA: 03 17 16.1750 (49.3173958d) Dec: -85 32 25.45 (-85.54040d) Equinox: J2000		V=14.6+/-0.1 B-V=-0.16, U-B=-1.13, V-R=0.01, V-I=-0.11, Fmag=15.09	Reference Frame: ICRS
Comments: Prime science target					
(2)	LB9802 Alt Name1: GSC2.0100330406	RA: 03 17 19.3050 (49.3304375d) Dec: -85 32 31.15 (-85.54199d) Equinox: J2000		V=14.1+/-0.1 B-V=-0.16, U-B=-1.13, V-R=0.01, V-I=-0.11, Fmag=14.22	Reference Frame: ICRS
Comments: White Dwarf star					
(3)	REF1 Alt Name1: S0100330424	RA: 03 20 12.9360 (50.0539000d) Dec: -85 34 56.17 (-85.58227d) Equinox: J2000		V=9.46+/-0.1	Reference Frame: ICRS
(4)	REF2 Alt Name1: S0100330428	RA: 03 18 52.0050 (49.7166875d) Dec: -85 35 20.76 (-85.58910d) Equinox: J2000		V=12.54+/-0.1 Fpg=11.8, Jpg=12.8	Reference Frame: ICRS
Comments: F8V (estimate spectral type)					
(8)	REF6 Alt Name1: S010330376	RA: 03 13 59.7170 (48.4988208d) Dec: -85 30 15.61 (-85.50434d) Equinox: J2000		V=14.25+/-0.1 Fpg = 13.7, Jpg=15.2	Reference Frame: ICRS
Comments: K1V (estimated spectral type)					
(9)	REF7 Alt Name1: S0100330378	RA: 03 15 55.9410 (48.9830875d) Dec: -85 30 19.59 (-85.50544d) Equinox: J2000		V=14.98+/-0.1 Fpg = 14.5, Jpg = 15.7	Reference Frame: ICRS
Comments: G6V (estimated spectral type)					
(10)	REF8 Alt Name1: S0100330374	RA: 03 16 46.3130 (49.1929708d) Dec: -85 29 48.04 (-85.49668d) Equinox: J2000		V=14.25+/-0.1 Fpg = 13.9, Jpg = 14.9	Reference Frame: ICRS
Comments: F8V (estimated spectral type)					

Fixed Targets (continued)

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(11)	REF9	RA: 03 18 55.0770 (49.7294875d)		V=14.36+/-0.1	Reference Frame: ICRS
	Alt Name1: S0100330440	Dec: -85 36 42.36 (-85.61177d)		Fpg = 13.89,	
		Equinox: J2000		Jpg = 14.89	

Comments: F8V (estimated spectral type)

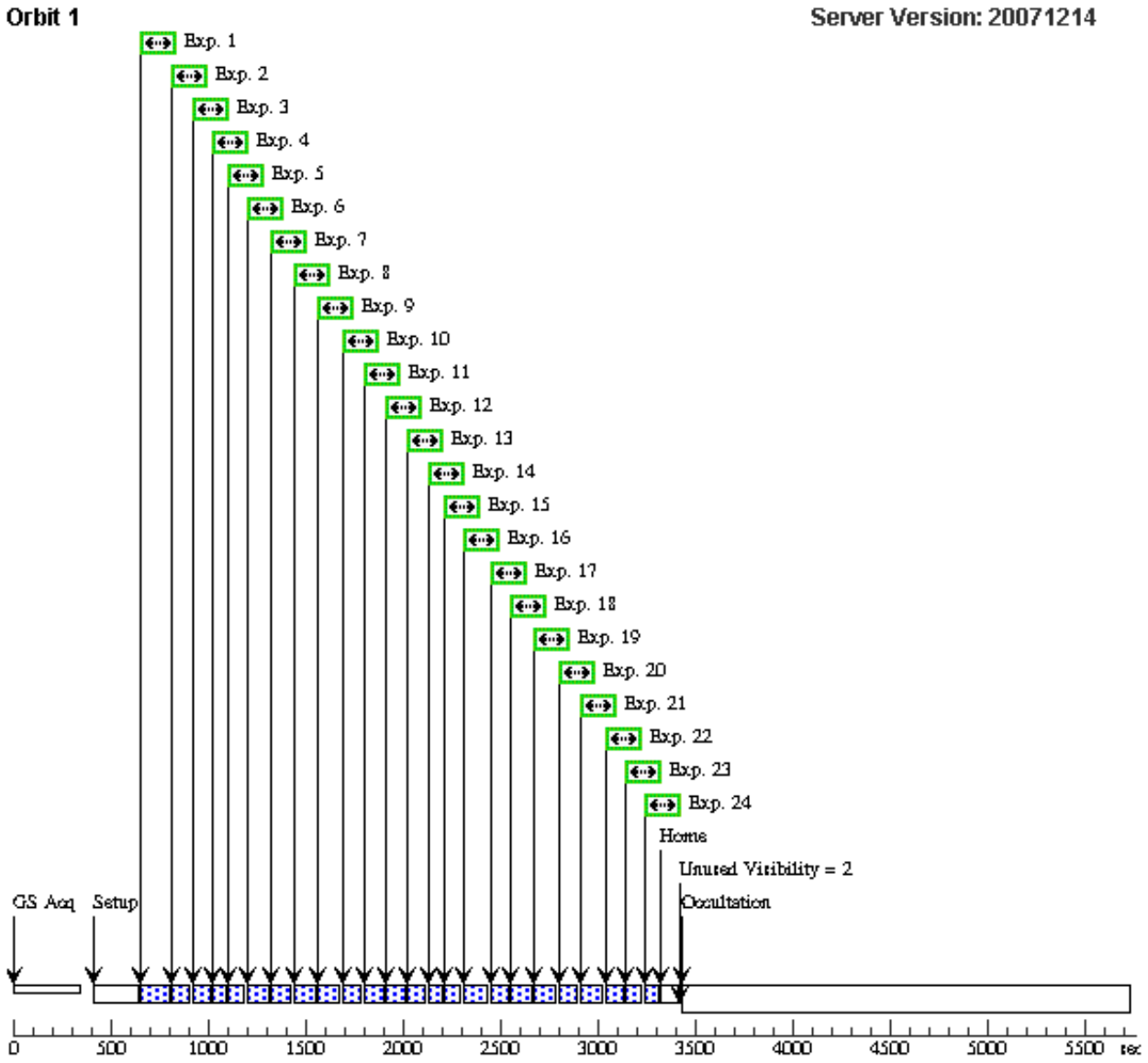
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) RE-0317-853	FGS, POS, 1	F583W		POS TARG 0.0,-30.0	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
2		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
3		(3) REF1	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
4		(4) REF2	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
5		(11) REF9	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
6		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
7		(1) RE-0317-853	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
8		(8) REF6	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
9		(9) REF7	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
10		(10) REF8	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
11		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
12		(1) RE-0317-853	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
13		(3) REF1	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	19.0 Secs	
								[==>]	***[1]***

Exposures (continued)

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
14		(4) REF2	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
15		(11) REF9	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
16		(1) RE-0317-853	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
17		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
18		(8) REF6	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
19		(9) REF7	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
20		(10) REF8	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
21		(1) RE-0317-853	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
22		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
23		(3) REF1	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	19.0 Secs	
								[==>]	***[1]***
24		(4) REF2	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***

Orbit Structure



Visit

Proposal 11300, Visit 02 Fri Jan 18 10:37:51 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: FGS

Special Requirements: SCHED 70%; ORIENT 138.0D TO 138.0 D; BETWEEN 24-MAR-2008:00:00:00 AND 30-MAR-2008:00:00:00

Comments: Two Guide Star FineLock Required.

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(4)	REF2 Alt Name1: S0100330428	RA: 03 18 52.0050 (49.7166875d) Dec: -85 35 20.76 (-85.58910d) Equinox: J2000		V=12.54+/-0.1 Fpg=11.8, Jpg=12.8	Reference Frame: ICRS
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Comments: F8V (estimated spectral type)					

Fixed Targets (continued)

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	Alt Name1: S0100330440	Dec: -85 36 42.36 (-85.61177d)		Fpg = 13.89,	
		Equinox: J2000		Jpg = 14.89	

Comments: F8V (estimated spectral type)

Exposures

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								[==>]	***[1]***
2		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
3		(3) REF1	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
4		(4) REF2	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
5		(11) REF9	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
6		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
7		(1) RE-0317-853	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
8		(8) REF6	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
9		(9) REF7	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
10		(10) REF8	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
11		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
12		(1) RE-0317-853	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
13		(3) REF1	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	19.0 Secs	
								[==>]	***[1]***

Exposures (continued)

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
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								[==>]	***[1]***
15		(11) REF9	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
16		(1) RE-0317-853	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
17		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
18		(8) REF6	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
19		(9) REF7	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
20		(10) REF8	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
21		(1) RE-0317-853	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
22		(2) LB9802	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***
23		(3) REF1	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	19.0 Secs	
								[==>]	***[1]***
24		(4) REF2	FGS, POS, 1	F583W		SAME POS AS 1	Sequence 1-24 Non-Int	24.0 Secs	
								[==>]	***[1]***

Orbit Structure