

The discovery of the First Eclipsing White Dwarf Binary System

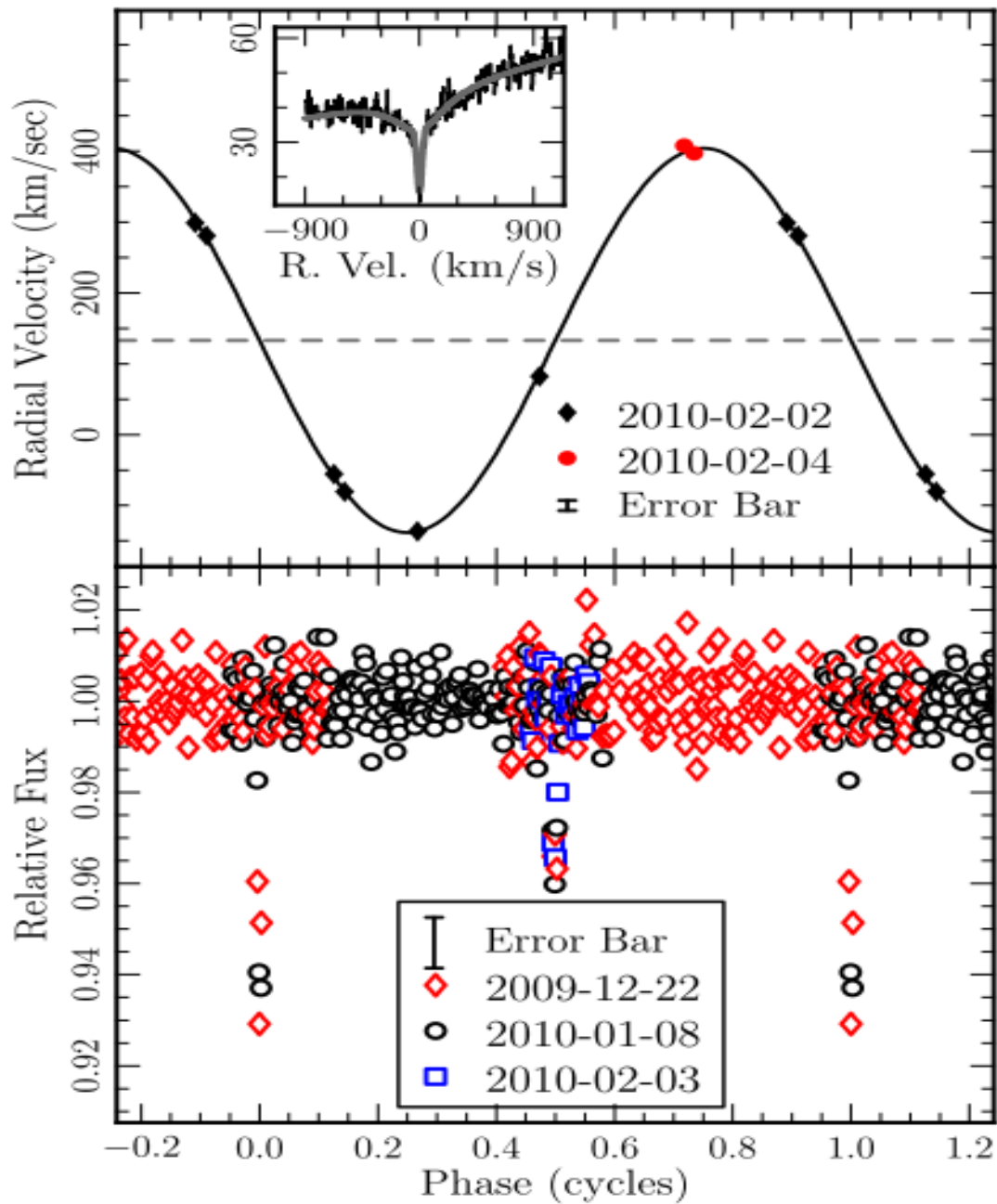
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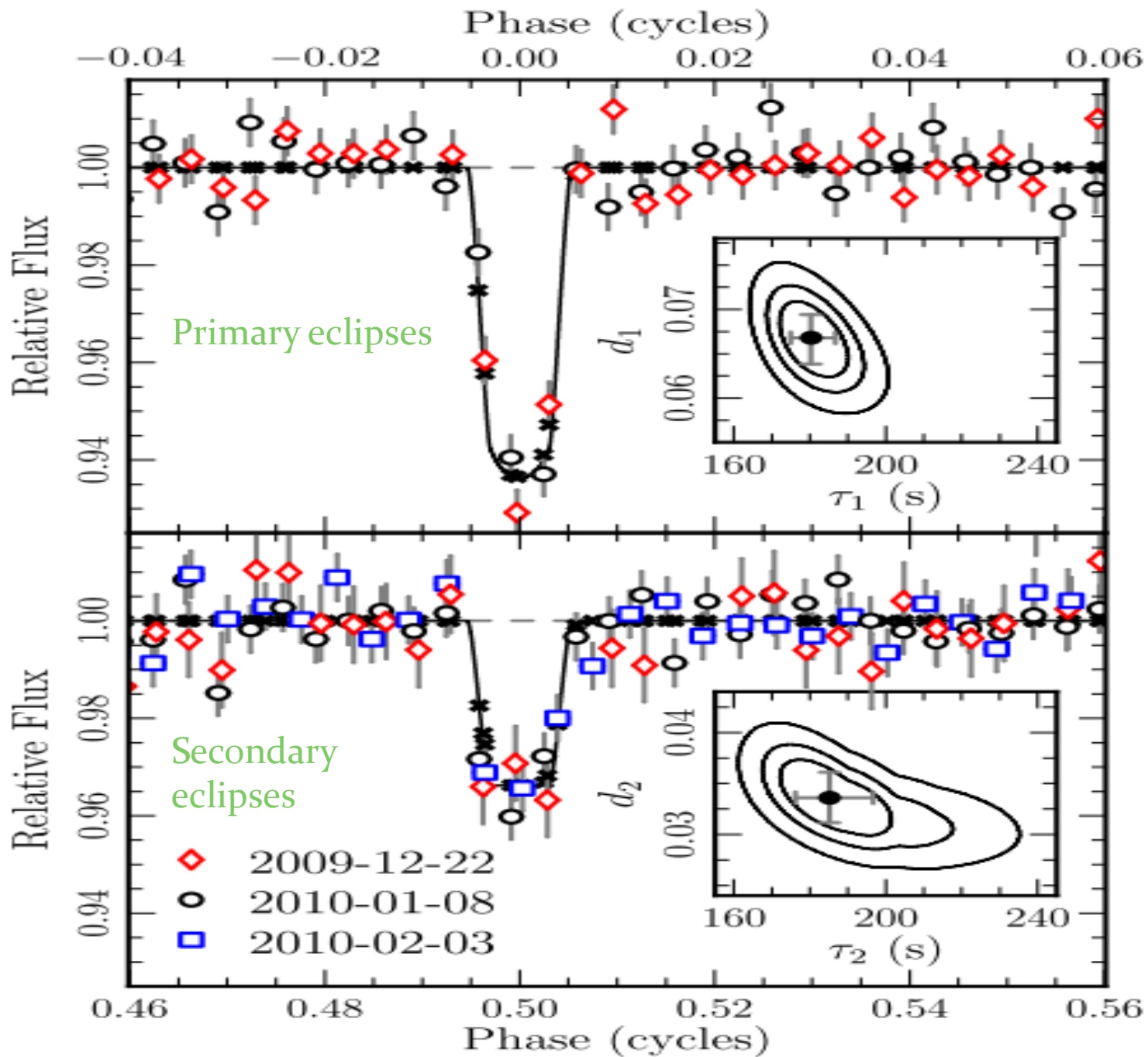
NLTT 11748

- Low mass ($\sim 0.167 \pm 0.005$ solar mass) helium core white dwarf
- $T_{\text{eff}} = 8540 \pm 50$ K
- H rich atmosphere
(Kawka & Vennes 2009 *A&A*)
- Theoretical works on the low mass He-core WD suggest that the WDs undergo stable H burning for Gyrs, slowing their evolution and keeping brighter for much longer than expected.
- The size of this kind of WD had never been measured.

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- $P_{\text{orb}} \sim 5.6$ hrs
- 180-sec 3-6% dips in the photometry is discovered by Faulkes Telescope North of the Las Cumbres Observatory Global Telescope.
- Radial velocity is measured by Keck telescope:
 $v_r = 133 \pm 2$ km/s
 $K_1 = 271 \pm 3$ km/s





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- There are 6 relevant binary parameters to be fitted:
masses: M_1, M_2
radii: R_1, R_2
flux ratio: F_1/F_2
inclination: i
- The limb darkening coefficient and the orbital period are fixed in the fitting.
- The microlensing effect is included in the fitting.

Quantity	Value		
HIRES spectra:			
Rad. Vel. Amp. K_1 (km s ⁻¹) . . .	271(3)		
Sys. Radial Velocity (km s ⁻¹) . . .	133(2)		
χ^2 /DOF	4.5/6		
FTN photometry:			
Time of Prim. Ecl. (BJD TDB)	2,455,196.87828(7)		
Period (days)	0.2350606(11)		
Ephemeris χ^2 /DOF	3.5/3		
Primary Eclipse Depth d_1	0.067(3)		
Secondary Eclipse Depth d_2	0.034(2)		
Primary Ecl. Duration τ_1 (s)	180(6)		
Secondary Ecl. Duration τ_2 (s)	185(10)		
F_2/F_1 (in SDSS- g')	0.035(3)		
Out of Eclipse ^a χ^2 /DOF	404.8/372		
Combined data (assuming Mass of Primary $M_1 = 0.15M_\odot$):			
Limb Darkening Coeff. u_{LD}	0.0	0.3	0.5
Mass of Secondary M_2 (M_\odot)	0.71(2)	0.71(2)	0.71(2)
Inclination (deg)	89.90(11)	89.88(11)	89.87(11)
Radius of Primary R_1 (R_\odot)	0.0393(9)	0.0406(9)	0.0415(9)
χ^2 /DOF ^b	285.1/227	279.5/227	276.5/227
Distance ^c (pc)	150(32)		
Sys. Kin. (U, V, W) ^d (km s ⁻¹)	(-151(9), -183(41), -34(5))		

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- $i \sim 90^\circ$
- $R_2/R_1 \sim 1/4$ derived from eclipse depths
- $T_2 \leq 7400$ K
- $M_2 = 0.648 - 0.771$ solar mass for $M_1 = 0.1 - 0.2$ solar mass
→ The secondary WD should be a faint C/O WD

- $R_1 = 0.043 - 0.039$ solar radius for $M_1 = 0.1 - 0.2$ solar mass
- The observations of the star NLTT 11748 have made the first direct radius measurement and the radius value is consistent with the theoretically expected values for a He-core WD with thick, stably burning hydrogen envelope.

References

- Astrophysicists discover unique eclipsing binary star system(<http://www.astronomy.com/asy/default.aspx?c=a&id=9870>)
- Unique Eclipsing Binary Star System Discovered (<http://www.sciencedaily.com/releases/2010/05/100519092704.htm>)
- Discovery of the Eclipsing Detached Double White Dwarf Binary NLTT 11748
Justin D. R. Steinfadt et al.
arXiv:1005.1977[astro-ph.SR]



>>Thank You<<