

## Atividades desenvolvidas em 2012-2013

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Divisão de Astrofísica  
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23 de abril de 2013

## Projetos de Pesquisas

Caracterização de sistemas binários eclipsantes

Busca por exoplanetas usando o instante de eclipses e trânsitos

Caracterização de Júpiteres quentes

Anomalias em eventos de microlentes gravitacionais

# Sumário

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Anomalias em eventos de microlentes gravitacionais

- Caracterização de sistemas binários eclipsantes;
- Busca por exoplanetas usando o instante de eclipses e trânsitos;
- Caracterização de Júpiteres quentes;
- Anomalias em eventos de microlentes gravitacionais;
- Astrometria de sistemas múltiplos de baixa massa

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Projetos de Pesquisas

**Caracterização de sistemas binários eclipsantes**

Busca por exoplanetas usando o instante de eclipses e trânsitos

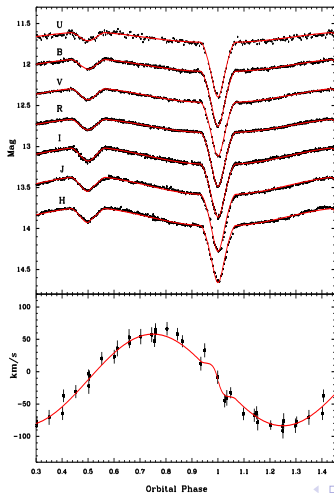
Caracterização de Júpiteres quentes

Anomalias em eventos de microlentes gravitacionais

# NSVS 14256825 - Segundo sistema descoberto do tipo sdOB + dM eclipsante



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# NSVS 14256825 - Segundo sistema descoberto do tipo sdOB + dM eclipsante

## A photometric and spectroscopic study of NSVS 14256825: the second sdOB+dM eclipsing binary\*

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*Instituto Nacional de Pesquisas Espaciais/MCTI, Av. dos Astronautas 1758, São José dos Campos, SP, 12227-010, Brazil*

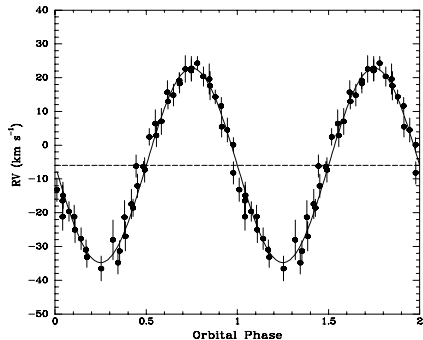
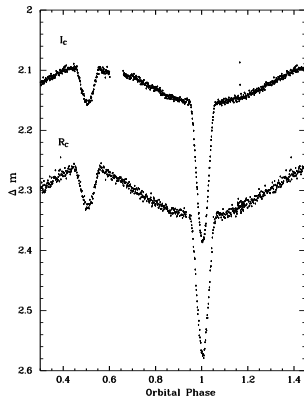
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### ABSTRACT

We present an analysis of UBVR<sub>c</sub>LCJH photometry and phase-resolved optical spectroscopy of NSVS 14256825, an HW Vir type binary. The members of this class consist of a hot subdwarf and a main-sequence low-mass star in a close orbit ( $P_{orb} \sim 0.1$  d). Using the primary-eclipse timings, we refine the ephemeris for the system, which has an orbital period of 0.11037 d. From the spectroscopic data analysis, we derive the effective temperature,  $T_1 = 4000 \pm 500$  K, the surface gravity,  $\log g_1 = 5.50 \pm 0.05$ , and the helium abundance,  $n(\text{He})/n(\text{H}) = 0.003 \pm 0.001$ , for the hot component. Modelling simultaneously the photometric and spectroscopic data with the Wilson-Devinney code, we obtained the geometrical and physical parameters of NSVS 14256825. With an orbital inclination,  $i = 82.5 \pm 0.3$ , and mass ratio,  $q = M_2/M_1 = 0.260 \pm 0.012$ , the components of the system have  $M_1 = 0.419 \pm 0.070 M_\odot$ ,  $R_1 = 0.188 \pm 0.010 R_\odot$ ,  $M_2 = 0.109 \pm 0.023 M_\odot$ , and  $R_2 = 0.162 \pm 0.008 R_\odot$ . From its spectral characteristics, the hot star is classified as a sdOB star.



## HS2231+2441



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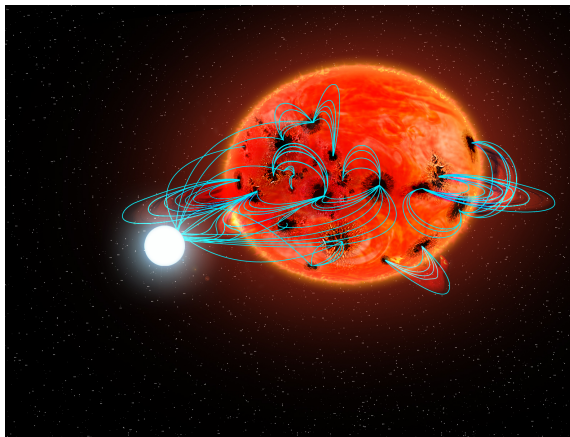
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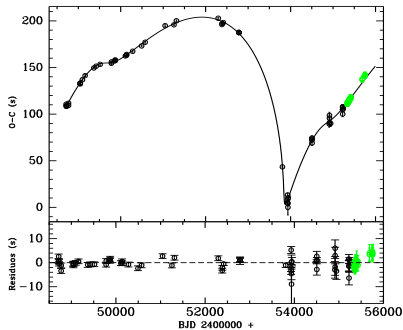
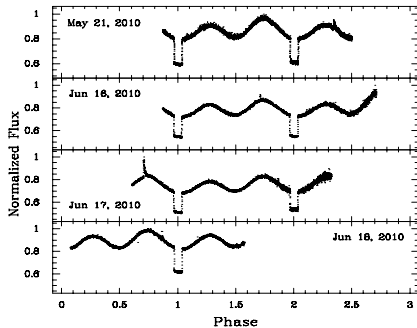
Anomalias em eventos de microlentes gravitacionais

## QS Vir - Concepção artística



# QS Vir - Dois corpos externos?

$$T_{\min} = T_0 + E \times P_{\text{orb}} + \tau_1 + \tau_2$$



## NSVS 14256825 - Dois corpos externos

$$T_{\min} = T_0 + E \times P_{\text{orb}} + \tau_1 + \tau_2$$

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TWO POSSIBLE CIRCUMBINARY PLANETS IN THE ECLIPSING POST-COMMON ENVELOPE SYSTEM NSVS 14256825\*

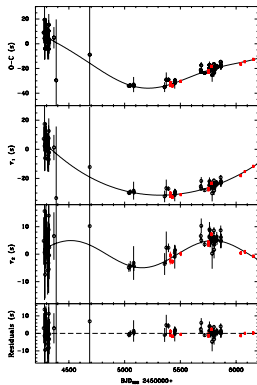
L. A. ALMEIDA, F. JABLONSKI, AND C. V. RODRIGUES

Divisão de Astrofísica, Instituto Nacional de Pesquisas Espaciais, São José dos Campos - SP, Brazil; [lalmeida@dm.inpe.br](mailto:lalmeida@dm.inpe.br)  
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ABSTRACT

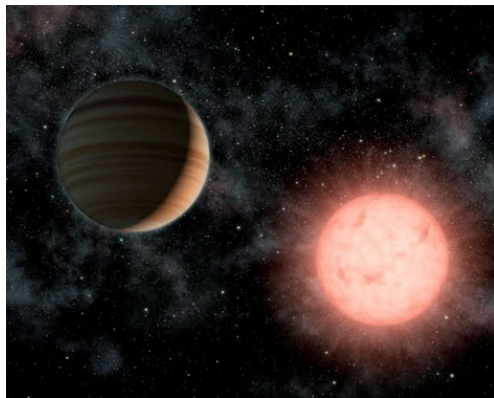
We present an analysis of eclipse timings of the post-common envelope binary NSVS 14256825, which is composed of an sdOB star and a dM star in a close orbit ( $P_{\text{orb}} = 0.110374$  days). High-speed photometry of this system was performed between 2010 July and 2012 August. Ten new mid-eclipse times were analyzed together with all available eclipse times in the literature. We revisited the  $(O - C)$  diagram using a linear ephemeris and verified a clear orbital period variation. On the assumption that these orbital period variations are caused by light travel time effects, the  $(O - C)$  diagram can be explained by the presence of two circumbinary bodies, even though this explanation requires a longer baseline of observations to be fully tested. The orbital periods of the best solution would be  $P_1 \sim 3.5$  years and  $P_2 \sim 6.9$  years. The corresponding projected semi-major axes would be  $a_1 \sin i_1 \sim 1.9$  AU and  $a_2 \sin i_2 \sim 2.9$  AU. The masses of the external bodies would be  $M_1 \sim 2.9 M_{\text{Jup}}$  and  $M_2 \sim 8.1 M_{\text{Jup}}$ , if we assume their orbits are coplanar with the close binary. Therefore NSVS 14256825 might be composed of a close binary with two circumbinary planets, though the orbital period variations is still open to other interpretations.

**Key words:** binaries: close – binaries: eclipsing – planetary systems – stars: individual (NSVS 14256825) – subdwarfs



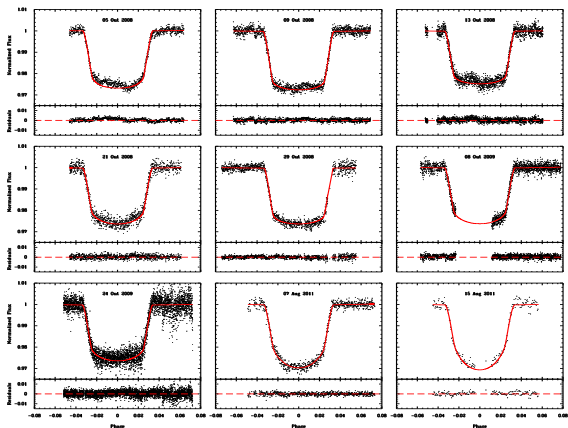
## Wasp-4b - Concepção Artística

Wilson et al (2008);  $0.97 M_{\odot}$ ;  $1.22 M_{\text{Jup}}$ ; 1.33 dias.

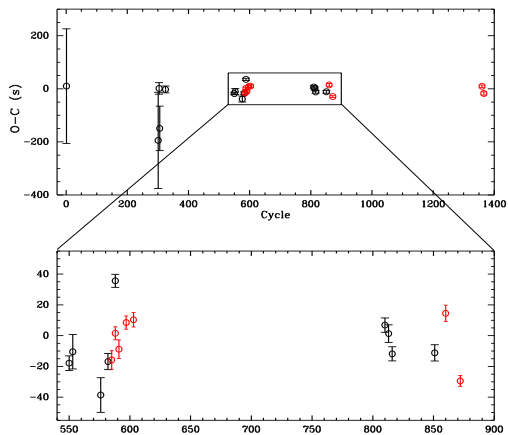


Fonte: <http://www.popularmechanics.com/science/space/deep/4335269>

# Wasp-4b - Trânsitos

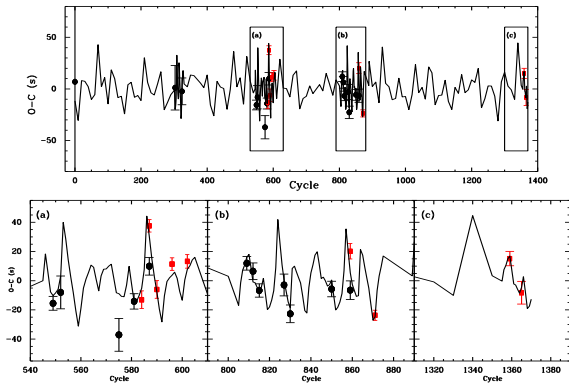


## Wasp-4b - Diagrama (O-C)





# Wasp-4b - Diagrama de Fase



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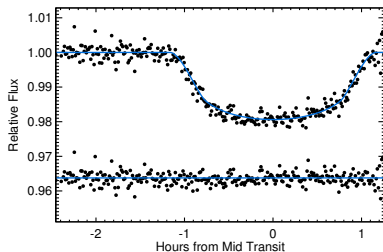
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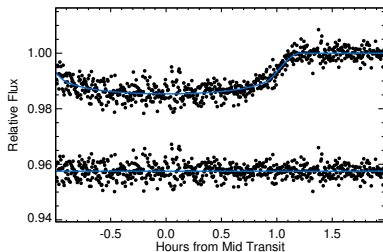
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# Alvos observados com o OPD

## Exoplaneta Wasp-44b



## Exoplaneta Wasp-5b



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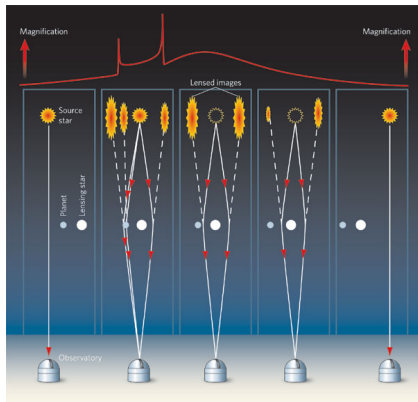
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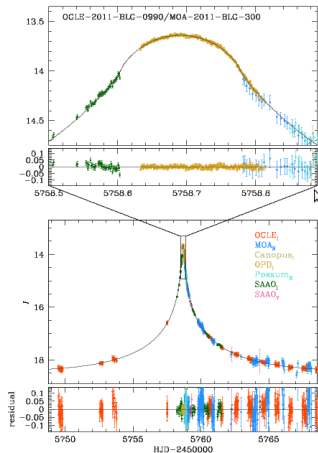
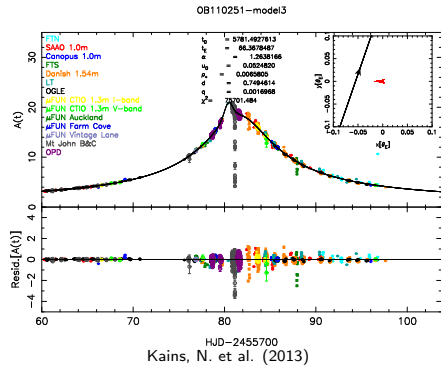
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## Concepção Artística



Fonte: <http://www.nature.com/nature/journal/v439/n7075/figtab/439400aF2.html>

## Alguns alvos observados com o OPD



Choi et al. (2012)

## Participação em Artigos

- 1 Han, C. et al.; THE SECOND MULTIPLE-PLANET SYSTEM DISCOVERED BY MICROLENSING: OGLE-2012-BLG-0026Lb, c A PAIR OF JOVIAN PLANETS BEYOND THE SNOW LINE. The Astrophysical Journal. Letters, v. 762, p. L28, 2013.
- 2 Kains, N. et al. A giant planet beyond the snow line in microlensing event OGLE-2011-BLG-0251. Astronomy & Astrophysics (Berlin. Print), v. 552, p. A70, 2013.
- 3 Gould, A. et al. MOA-2010-BLG-523: -FAILED PLANET- = RS CVn STAR. Astrophysical Journal (Online), v. 763, p. 141, 2013.
- 4 Street et al. MOA-2010-BLG-073L: AN M-DWARF WITH A SUBSTELLAR COMPANION AT THE PLANET/BROWN DWARF BOUNDARY. Astrophysical Journal (Online), v. 763, p. 67, 2013.
- 5 Choi et al. CHARACTERIZING LENSES AND LENSED STARS OF HIGH-MAGNIFICATION SINGLE-LENS GRAVITATIONAL MICROLENSING EVENTS WITH LENSES PASSING OVER SOURCE STARS. The Astrophysical Journal, v. 751, p. 41, 2012.
- 6 Bachelet et al. MOA 2010-BLG-477Lb: CONSTRAINING THE MASS OF A MICROLENSING PLANET FROM MICROLENSING PARALLAX, ORBITAL MOTION, AND DETECTION OF BLENDED LIGHT. The Astrophysical Journal, v. 754, p. 73, 2012.
- 7 Yee et al. OA-2011-BLG-293Lb: A TEST OF PURE SURVEY MICROLENSING PLANET DETECTIONS. The Astrophysical Journal, v. 755, p. 102, 2012.
- 8 Shin et al. CHARACTERIZING LOW-MASS BINARIES FROM OBSERVATION OF LONG-TIMESCALE CAUSTIC-CROSSING GRAVITATIONAL MICROLENSING EVENTS. The Astrophysical Journal, v. 755, p. 91, 2012.
- 9 Choi et al. A NEW TYPE OF AMBIGUITY IN THE PLANET AND BINARY INTERPRETATIONS OF CENTRAL PERTURBATIONS OF HIGH-MAGNIFICATION GRAVITATIONAL MICROLENSING EVENTS. Astrophysical Journal (Online), v. 756, p. 48, 2012.

Obrigado !

