Orbit and spots of UX Arietis

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Orbit and spots of UX Arietis

- Member of the class of RS CVn binaries
 - Sub-giant/giant primaries with MS companions
 - Spin-up due to co-rotation in short period orbits
 - Stellar activity:
 - H+K emission
 - Photometric variability
 - Radio emission and flares
- Observed with MIRC for 9 nights in 2012













Radio emission and X-rays





The need for observations





Mutel et al. 1985

Ros & Massi 2007





MIRC resolves binary and disk



LESIA









CHARA

Magic of Macim







Observatoire

6











APT light curves





MIRC spot model and light curve



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Fig. 4. Model images of the spots at phase zero (inferior conjunction of secondary in front of primary) also corresponding to maximum light in 2013, and at phase 0.5, corresponding to minimum light in 2012. Inverted heat color scale.

Parameter	Primary	Secondary
$T_{\rm eff}^1$	4520 K	5780 K
$\log g^1$	3.0	4.0
Diameter [mas]	0.97 ± 0.02	0.35 ± 0.02
Axial rotation / orbital rate		1
Limb darkening coefficient ²	0.30	0.23
Gravity darkening exponent	0.3^{3}	
Bolometric albedo	0.	7 ³

¹: See Sect. 3.3

²: H-band, linear law, van Hamme (1993)

³: Values for convective envelopes





Orbit of UX Arietis





CfA RV fits and light curves







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Stellar parameters

Table 8. Orbital parallax and stellar parameters

Parameter	Primary	Secondary	Tertiary
π [mas]	19.20	± 0.28	
Mass $[M_{\odot}]$	1.30 ± 0.06	1.14 ± 0.06	$0.75^1 \pm 0.01$
Radius ² [R_{\odot}]	5.6 ± 0.1	1.6 ± 0.2	0.8 ± 0.1
$T_{\rm eff}$ [K]	4600 ± 100	5750 ± 100	4800 ± 100
$\log g^3 [\text{cm/s}^2]$	3.06 ± 0.04	4.21 ± 0.16	4.51 ± 0.13
Luminosity ² [L_{\odot}]	13.5 ± 0.9	2.32 ± 0.25	0.41 ± 0.07

 $\overline{}^{1}$: Peterson et al. (2011)

²: From photometric model, see Sect. 4.1

³: Derived from mass and radius













Photometric model input

Table 9. Photometry for UX Arietis

Component	Band	Magnitude difference	Model fit
ABC	В	7.31 ± 0.05^5	7.30
ABC	V	6.42 ± 0.05^5	6.44
ABC	H	3.95 ± 0.1^5	3.93
ABC	Κ	3.83 ± 0.1^5	3.82
Ab-Aa	5187 Å	-0.00 ± 0.2^{1}	0.43
Ab-Aa	V	0.67 ± 0.2^2	0.75
Ab-Aa	H	1.83 ± 0.1^{1}	1.84
B-Ab	R	1.90 ± 0.1^2	1.91
B-A	Нр	3.15 ± 0.20^3	3.12
B-A	\overline{V}	3.06 ± 0.20^4	3.10
B-A	H	3.4 ± 0.40^{1}	3.6

References: ¹: This paper; ²: Aarum Ulvås & Engvold (2003a); ³: ESA (1997); ⁴: Horch et al. (2012); ⁵: SIMBAD













Stellar parameters

- Primary diameter fixed at 5.4 R_{\odot}
 - Adjust upwards by 1.5σ (Stefan-Boltzmann)
- Secondary constrained by photometry: 0.28 mas
 A bit less when compared to WD fit
- Primary T_{eff} = 4560 K (K1IV), spot @70%
 Compute bolometric luminosity with unspotted star
- Secondary $T_{eff} = 5670 \text{ K} \text{ (G4V)}$
- Tertiary $T_{eff} = 5030 \text{ K} (\text{K2V})$







Radio components and orbit



