

LONG-TERM MONITORING OF

AR LAC

WITH TIGRE

THE AR LAC SYSTEM

The brightest ($V = 6.1$ mag) RS CVn system (42.67 ± 0.05 pc)

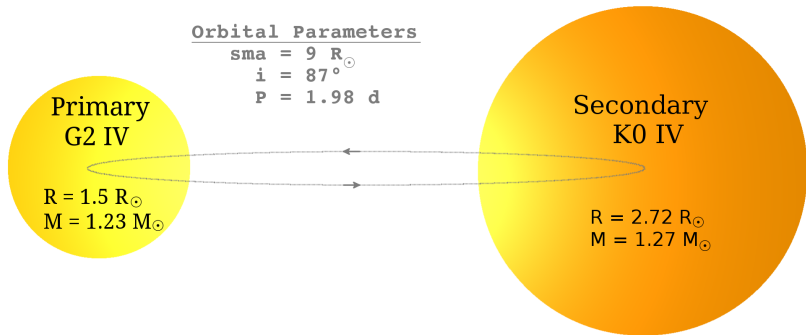


Figure: To-scale sketch of the AR Lac system.

THE LIGHT CURVE

Total and partial eclipses

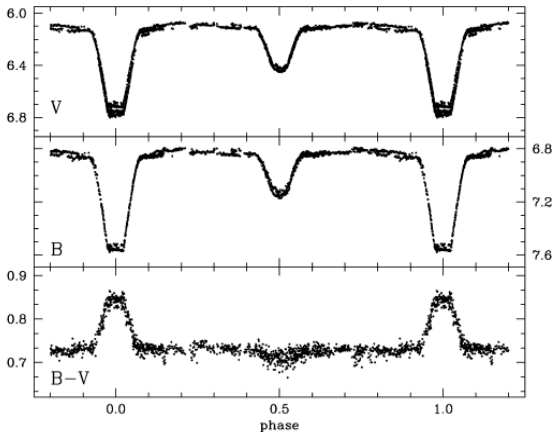
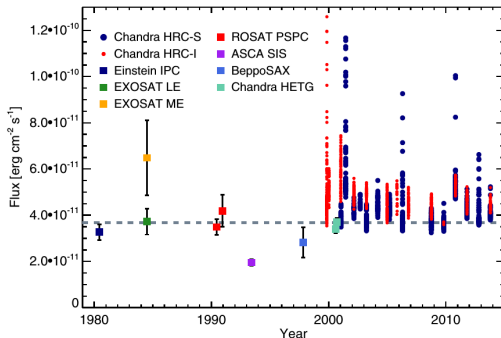


Figure: Light curve of the AR Lac system (from Siviero et al. 2006).

X-RAY EMISSION OF AR LAC



Long-term X-ray light curve of AR Lac (Drake et al. 2010, ApJ 783, 2).

$$L_X \approx (8 \pm 1) \times 10^{30} \text{ erg/cm}^2/\text{s over 33 yr}$$

TIGRE DATA OF AR LAC

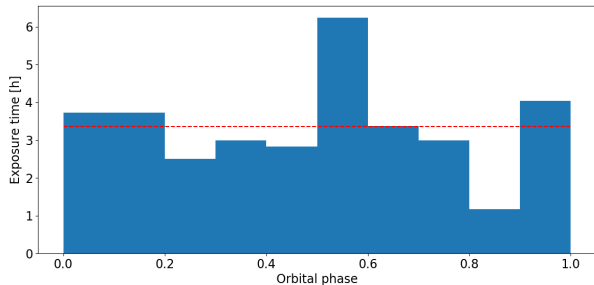
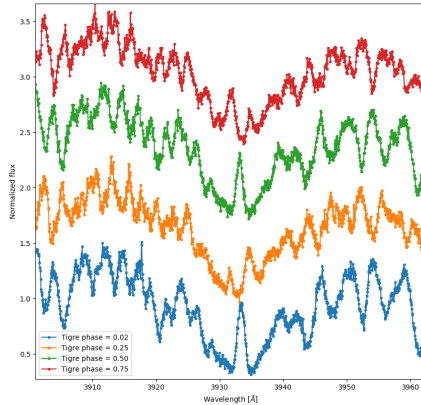


Figure: Orbital phase distribution of Tigre data

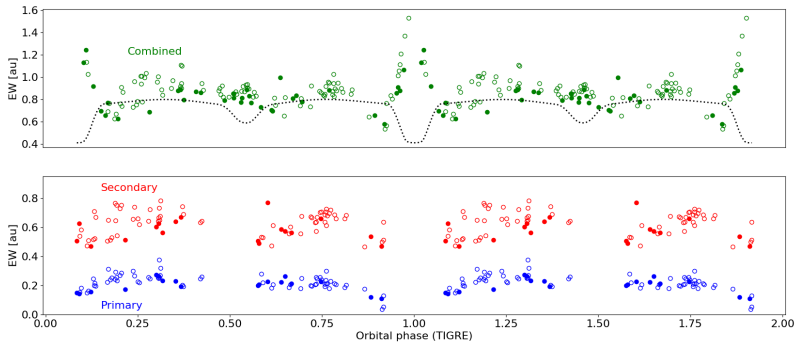
- First spectrum: 14. Aug. 2014
- No. of spectra: 128 (1 per 3 days)
- Total exposure time: 33.6 h (≈ 8.8 h/yr)

THE CA H&K EMISSION LINES



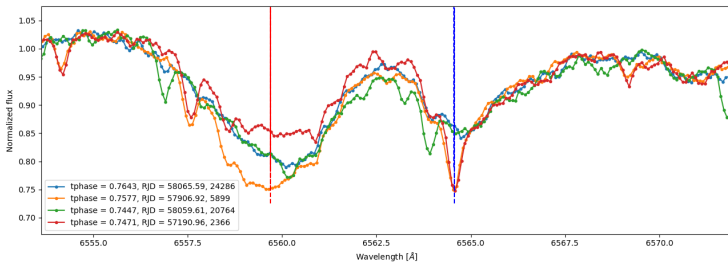
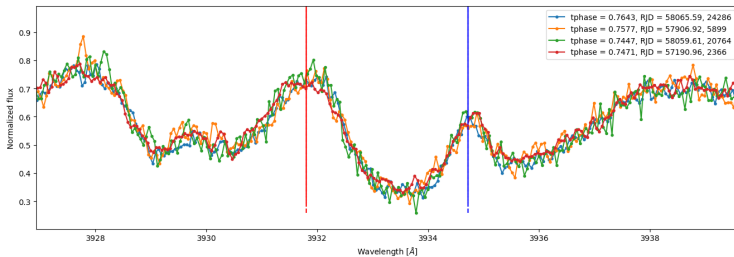
Phase evolution of Ca H&K emission lines

THE CA H&K EMISSION LINES



Phase evolution of the Ca K line(s). Filled circles before Aug. 2016.

CA H&K vs. H α



ECLIPSE TIME VARIATIONS

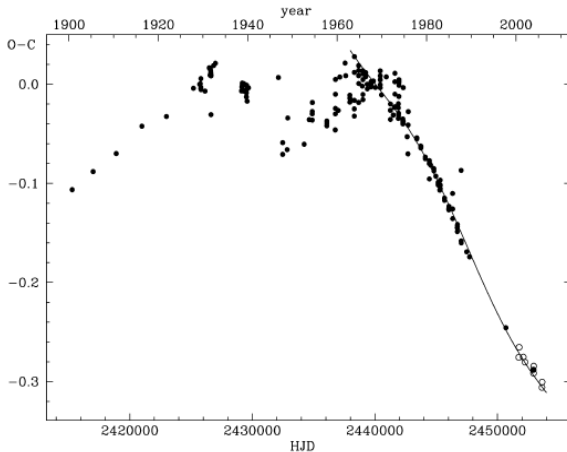


Figure: Eclipse time variations in AR Lac with respect to ephemeris given by Cester 1967 (from Siviero et al. 2006).

SPECTRAL MODELING

Spectral models based on Kurucz atmospheres:

Component	T_{eff}	$\log(g)$
Primary	5500 K	4.0
Secondary	5000 K	3.5

Spectral fit using various combinations of free parameters: $v \sin(i)$, rv , relative contribution, normalization.

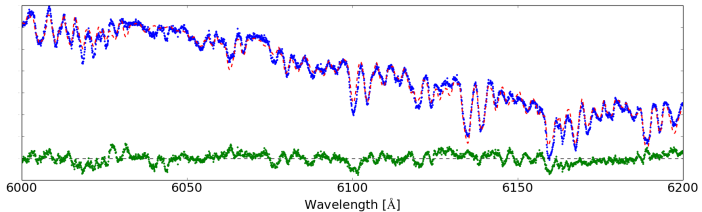


Figure: Spectrum (blue) and model (red) along with residuals (green).

Rotational velocities:

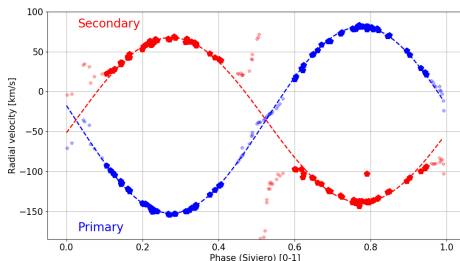
$$v \sin(i)_P = 46 \text{ km/s} \quad \text{and} \quad v \sin(i)_S = 69 \text{ km/s}$$

→ Compatible with bound rotation

Relative contribution at $\approx 6100 \text{ \AA}$:

Primary contributes $\approx 30\%$ of flux
→ Compatible with published radii and temperatures

RADIAL VELOCITIES



RVs for primary (blue) and secondary (red) with model (dashed).

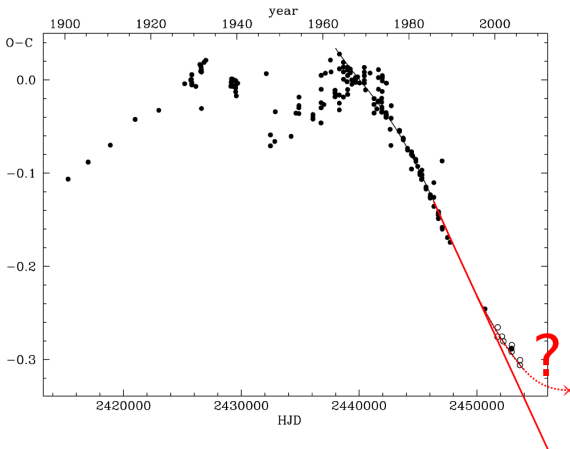
Parameter	Tigre	Frasca & Lanza 2000
K_1	116.8 ± 0.3 km/s	117.4 – 119.4
K_2	103.2 ± 0.3 km/s	106.7
RV_0	-35.6 ± 0.2 km/s	

Phase shift?

RADIAL VELOCITIES

Required shift with respect to ephemeris by Cester 1967:
 ≈ -0.32 d.

Tigre RV phase-shift in context



SUMMARY

Tigre obtained ≈ 4 yrs (33.6 *h*, 128 spectra, 1 per 3 days) of AR Lac.

With Tigre we can

- distinguish the individual spectral components,
- phase-resolve activity tracers (Ca H, H α , Ca IRT)
- determine timing variations from RVs,
- study activity on both stars.

Tigre produced a unique long-term spectral time series to study activity and orbital evolution.