

# *RW Aur binary: asymmetrical effect of the fly-by on the inner regions of circumstellar discs of the components*

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The 2<sup>nd</sup> international Workshop

The UX Ori type stars and related topics

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# Young binary system RW Aur

$D = 163 \text{ pc}$ ,  $d \approx 1.5 \text{ arcsec} \approx 240 \text{ au}$

## RW Aur A

$$L_* \approx L_{\text{ac}} \approx 1.5 L_{\odot}$$

$$T_{\text{eff}} \approx 5000 \text{ K} \quad (\text{K2})$$

$$R \approx 1.9 R_{\odot}$$

$$M \approx 1.4 M_{\odot}$$

## RW Aur B

$$L_* = 0.6 L_{\odot}, L_{\text{ac}} \ll L$$

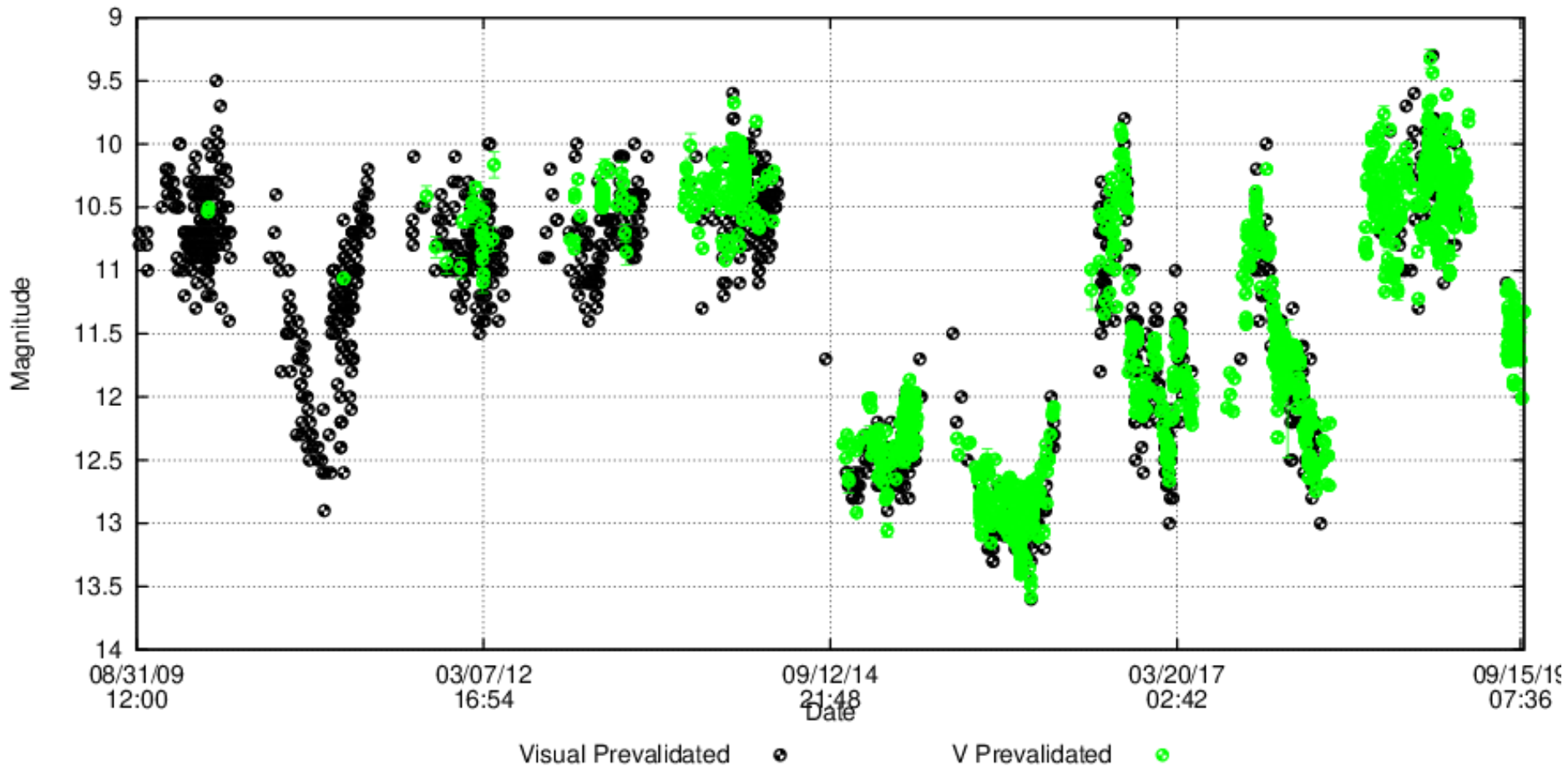
$$4100 \text{ K} \quad (\text{K7})$$

$$1.2 R_{\odot}$$

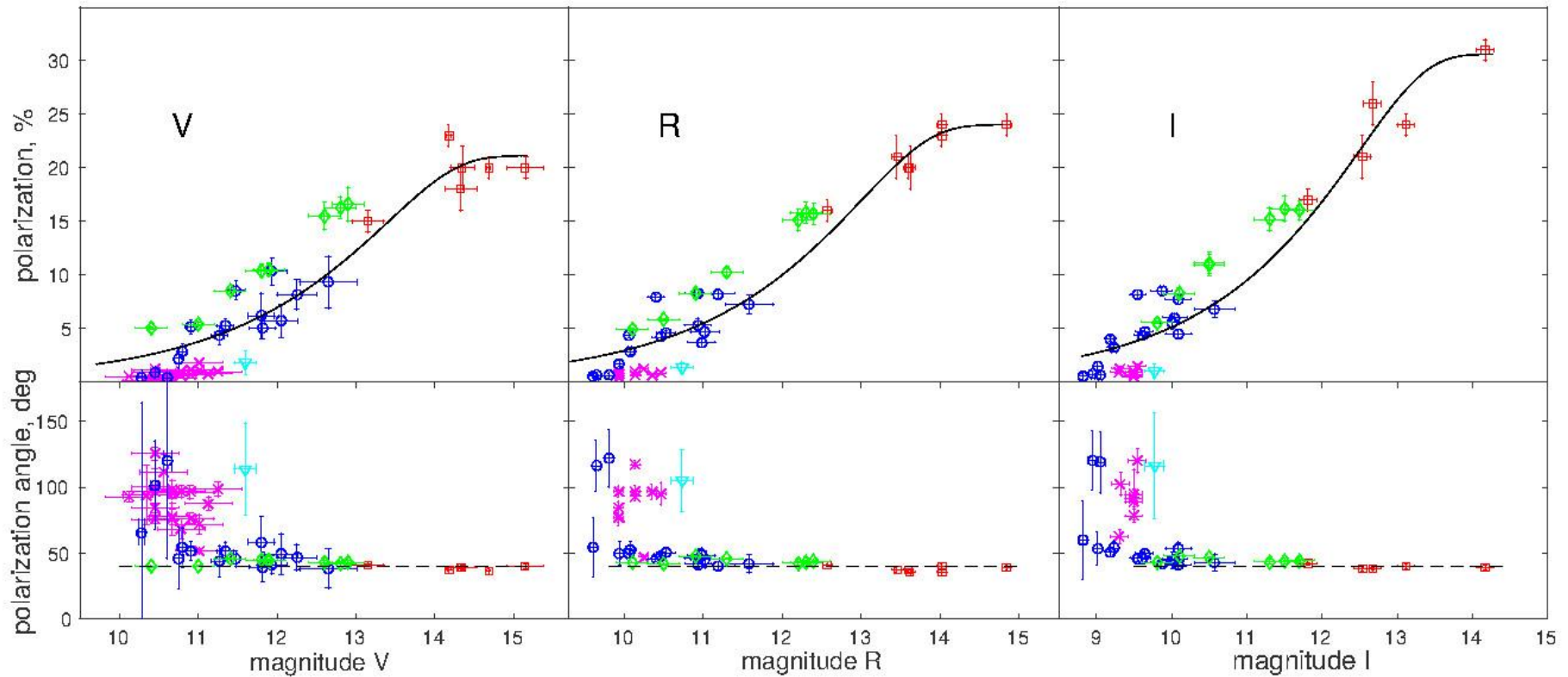
$$0.8 M_{\odot}$$

# AAVSO V-band light curve of RW Aur A+B from September, 2009 to September, 2019

AAVSO DATA FOR RW AUR - WWW.AAVSO.ORG



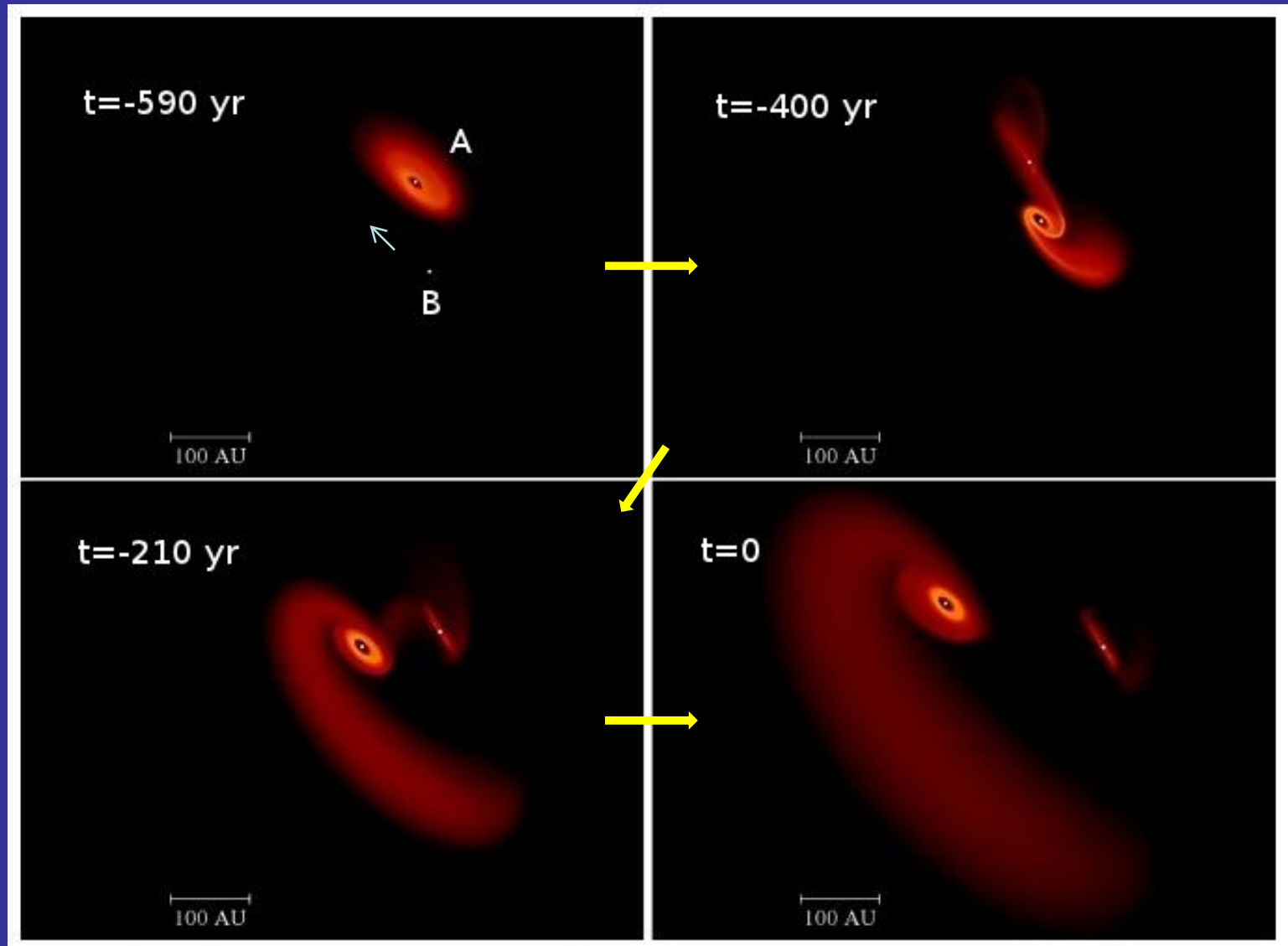
# Polarization-magnitude dependence For RW Aur A



*Dodin et al., 2019*

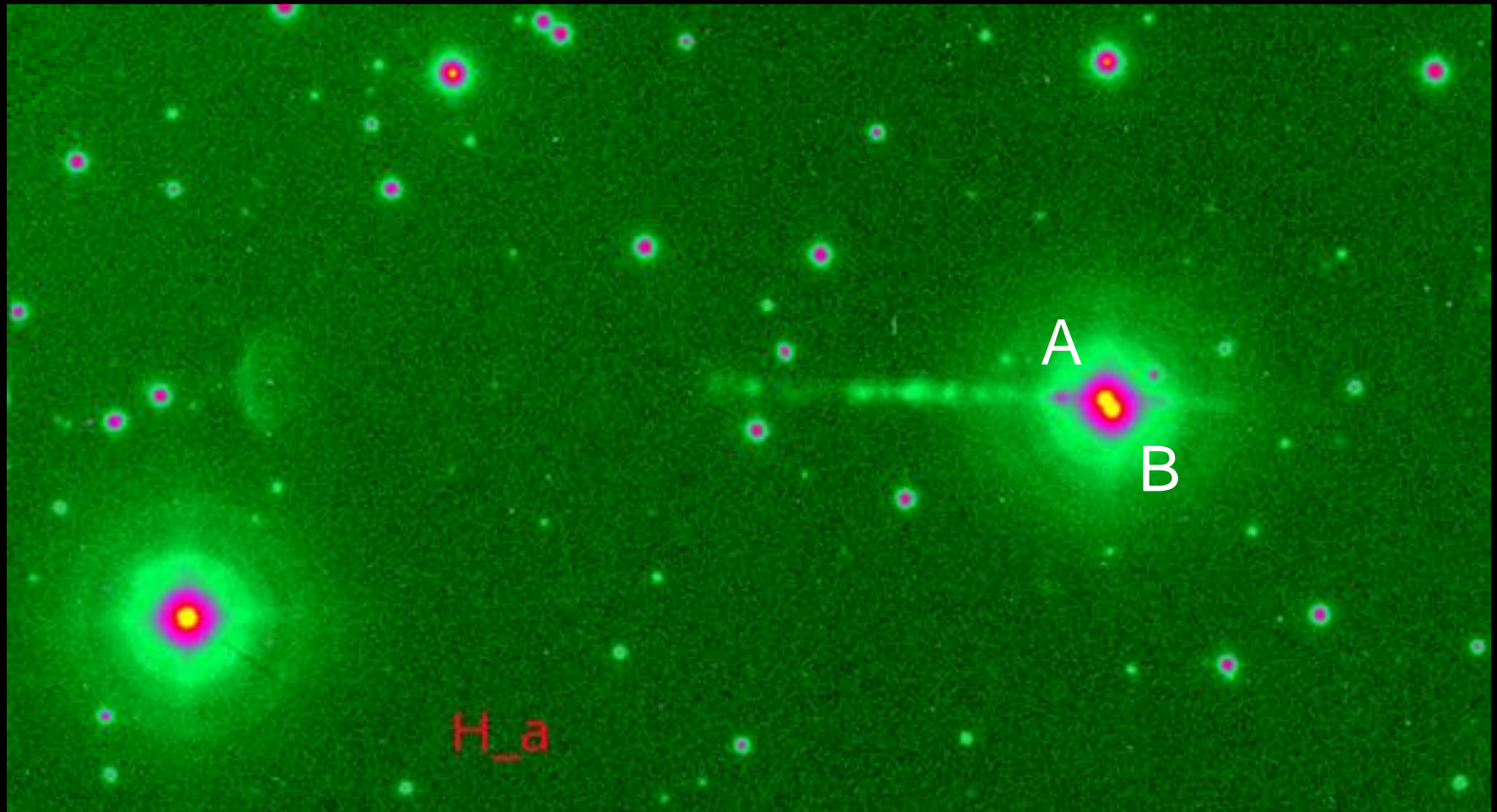
Eclipses are produced by dusty disk wind !!!

# Fly-by model



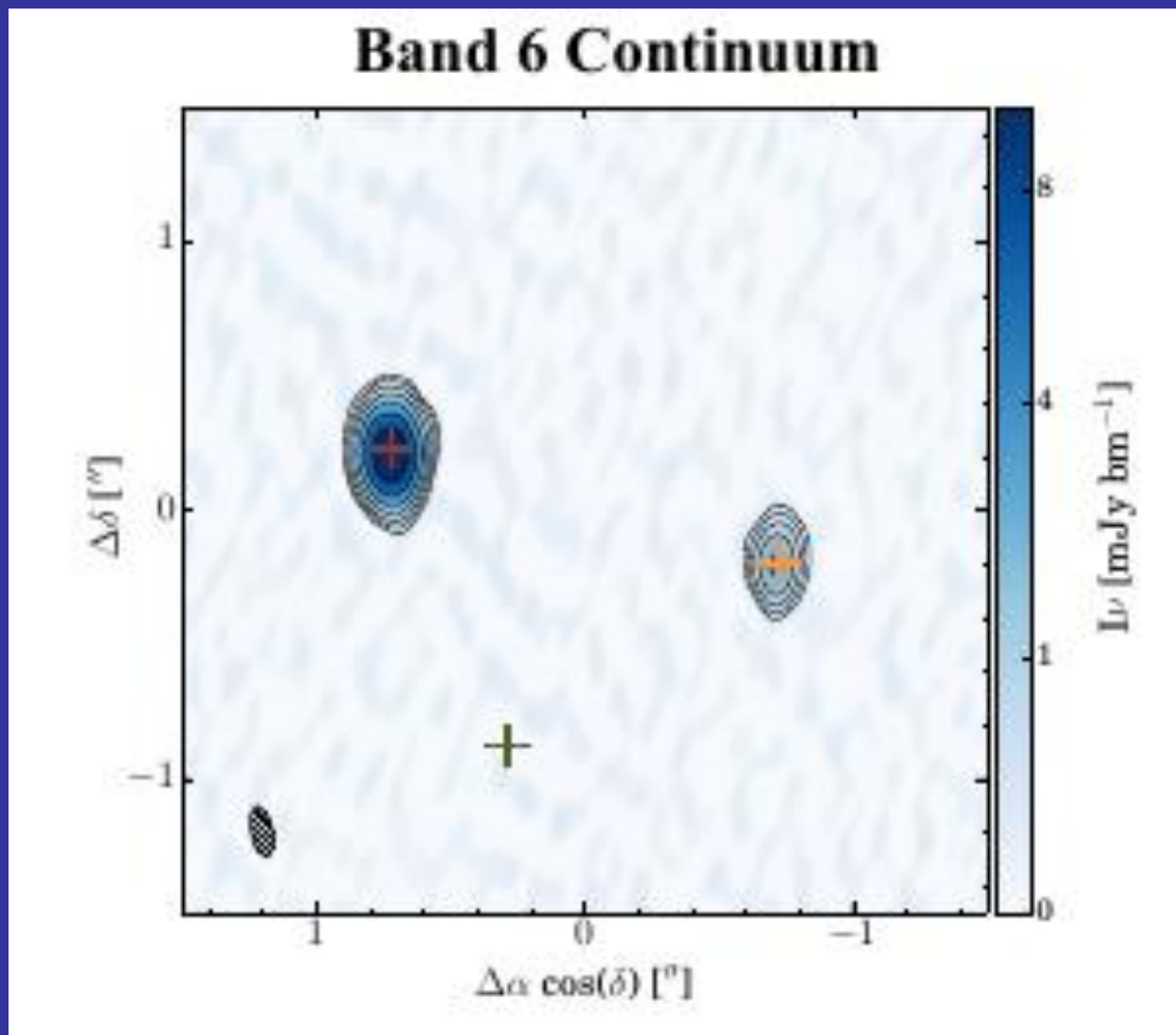
Dai . et al. (2015)

# Jet of RW Aur A (*Berdnikov et al., 2017*)

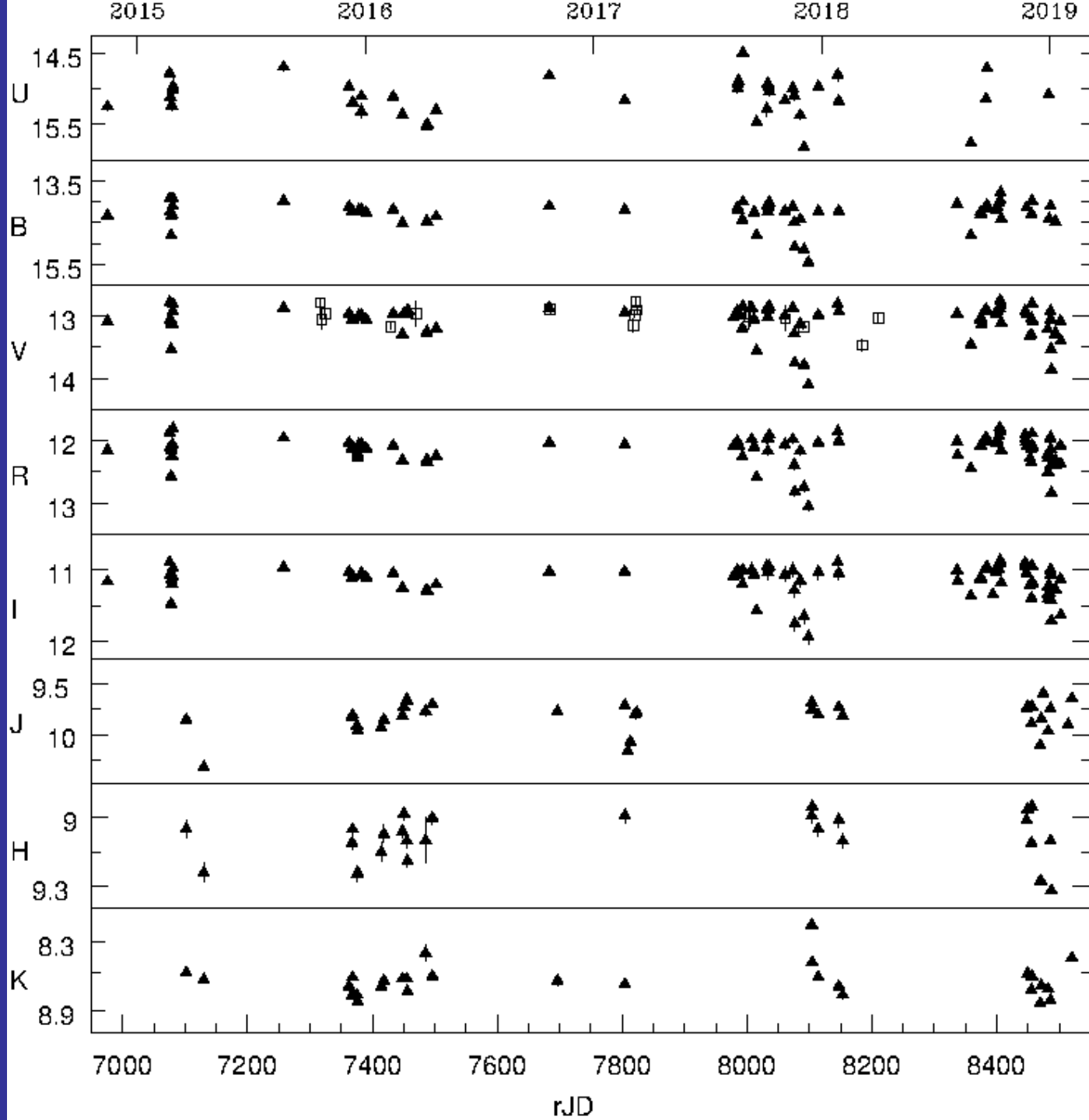


Interactions of components in double systems trigger accretion events that produce powerful outflows (*Reipurth, 2000*).

But RW Aur B also has disk,  
so what occurs with it ?

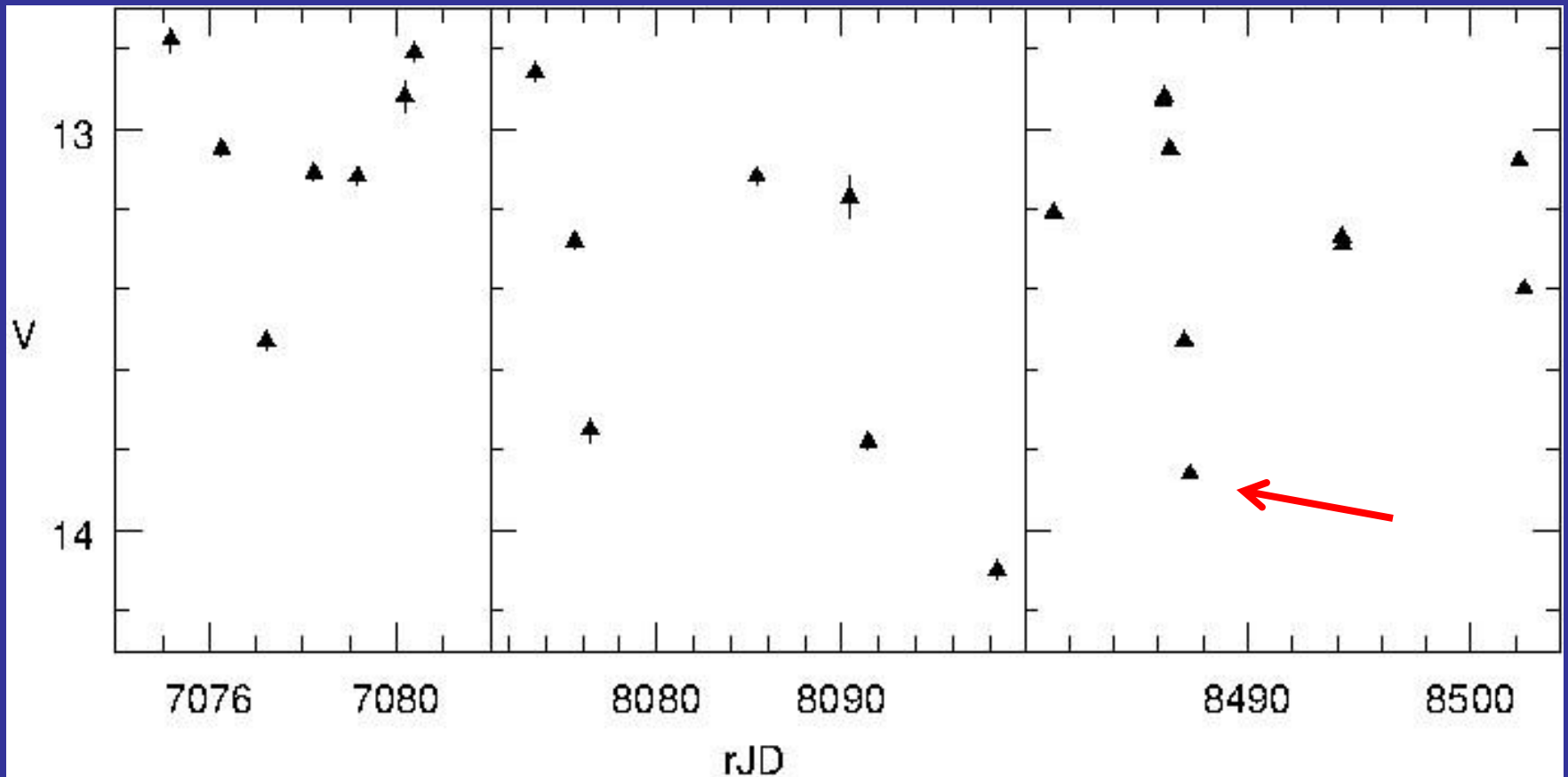


*Rodriguez et al., 2018*

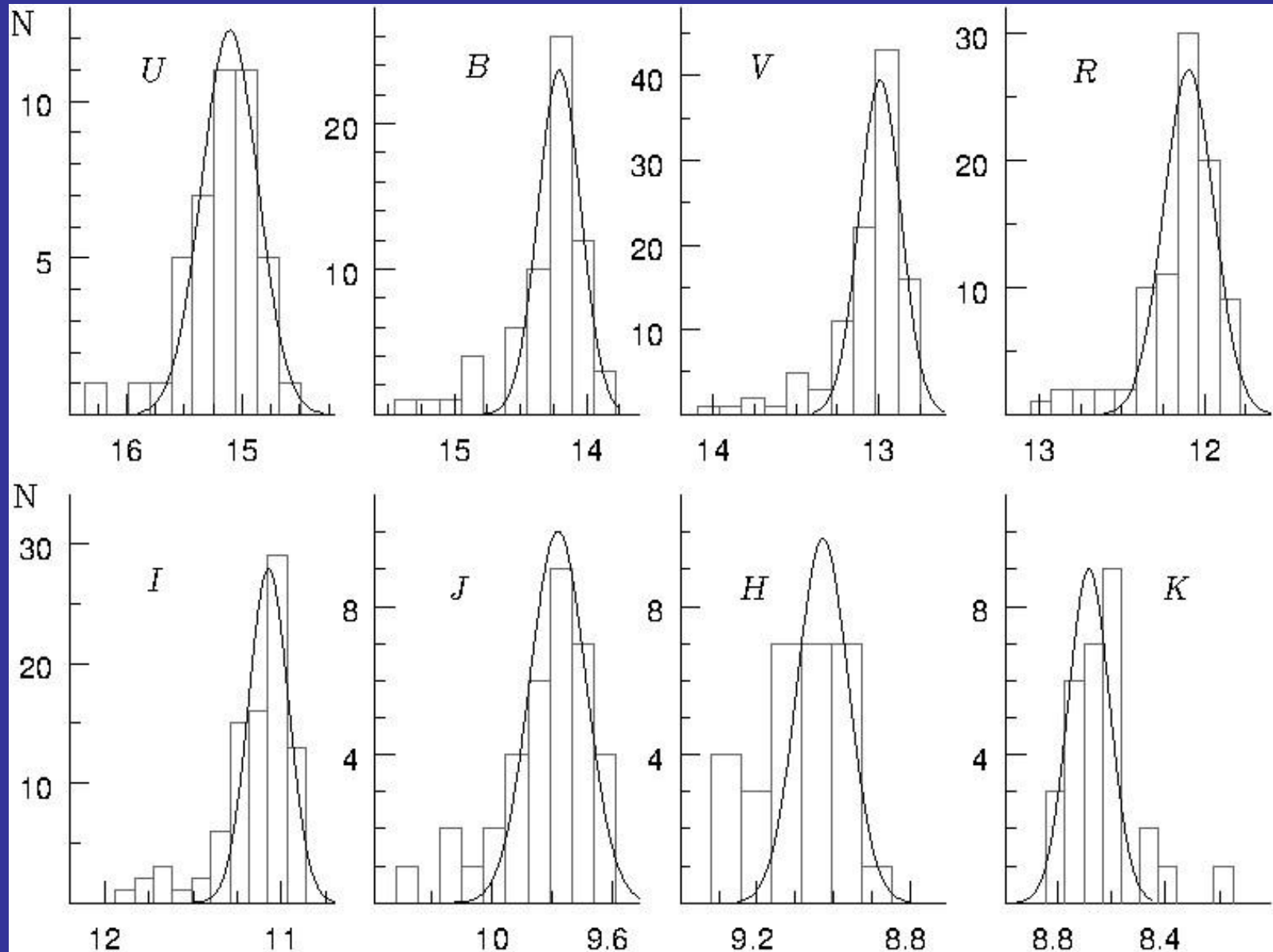




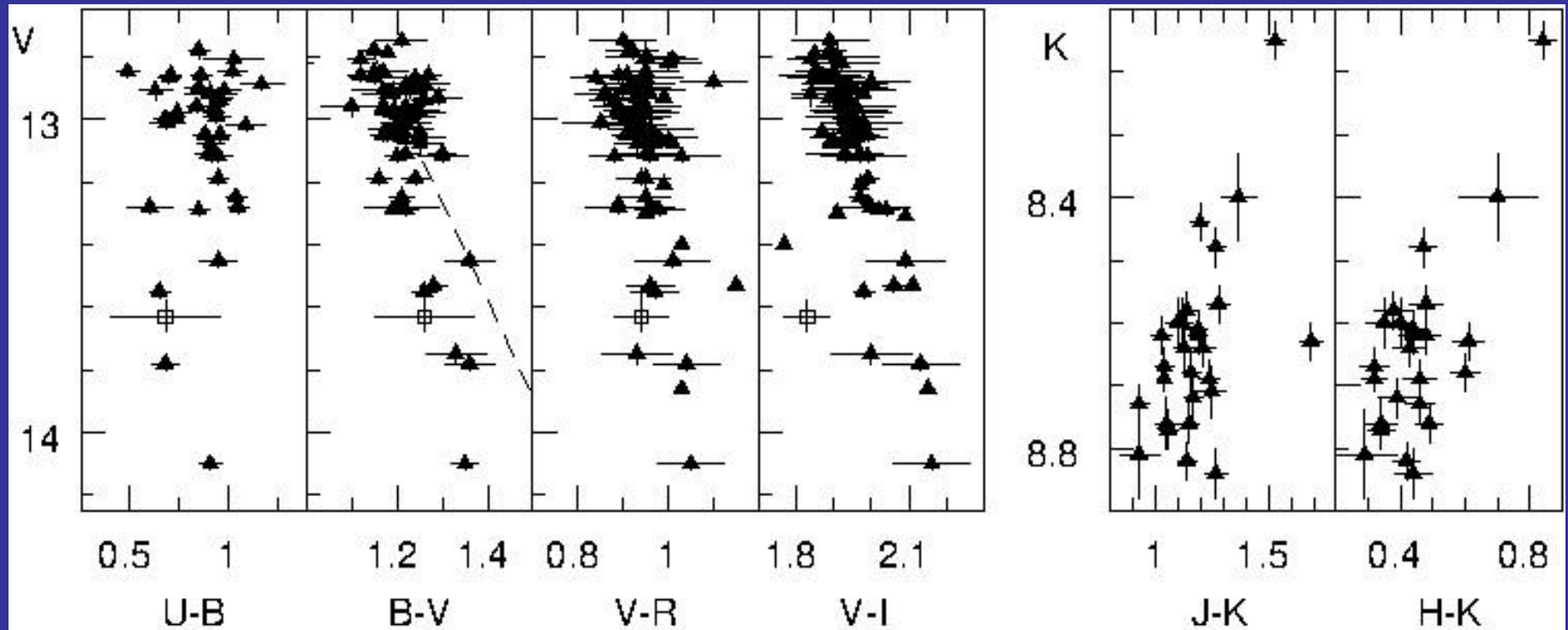
Fast dimmings: up to  $\Delta V \approx 1^m$  during one day



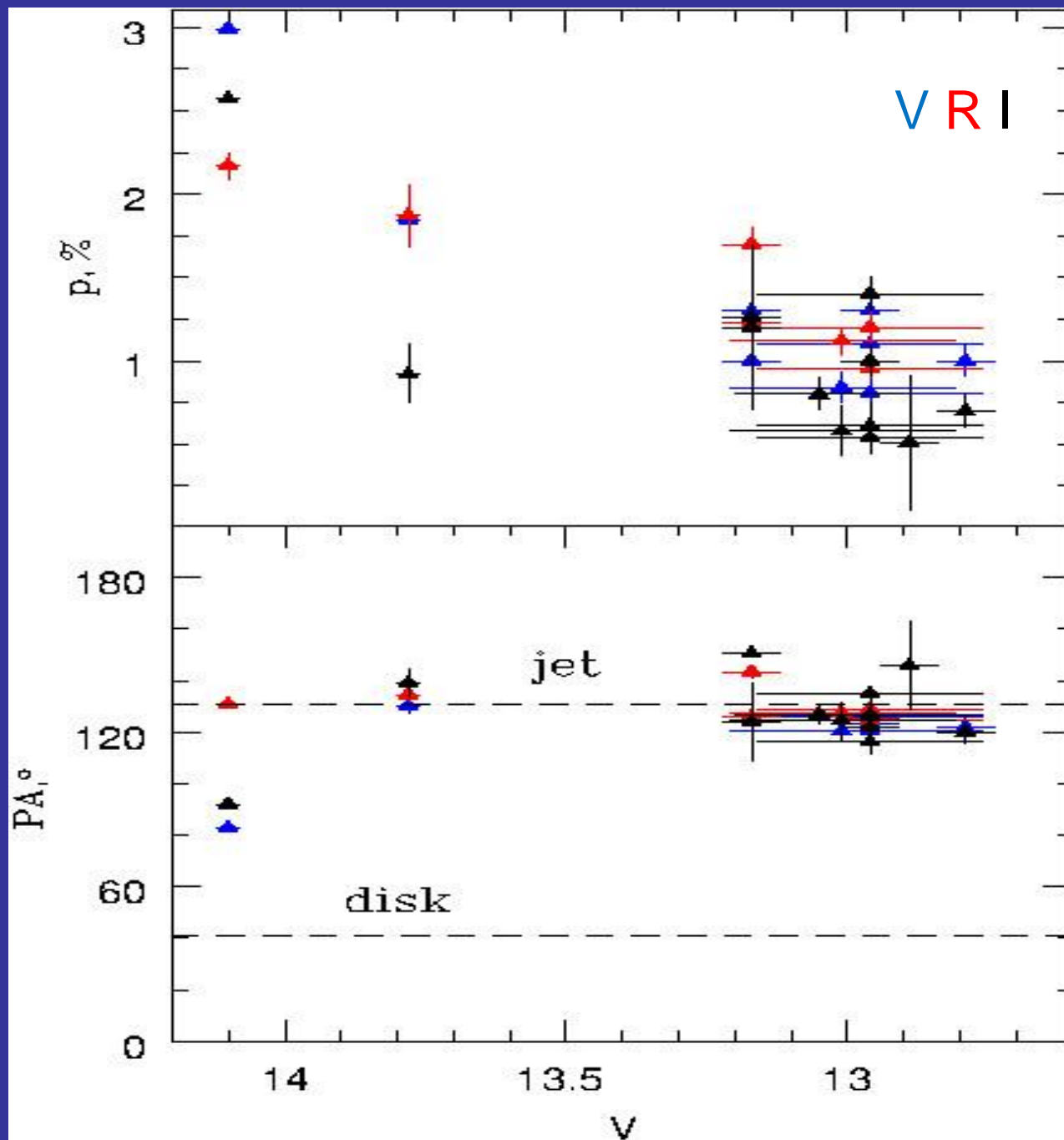
# U,..., J and H,K histograms are different



# Optical and NIR colour-magnitude diagrams are also different



Blueing effect ?



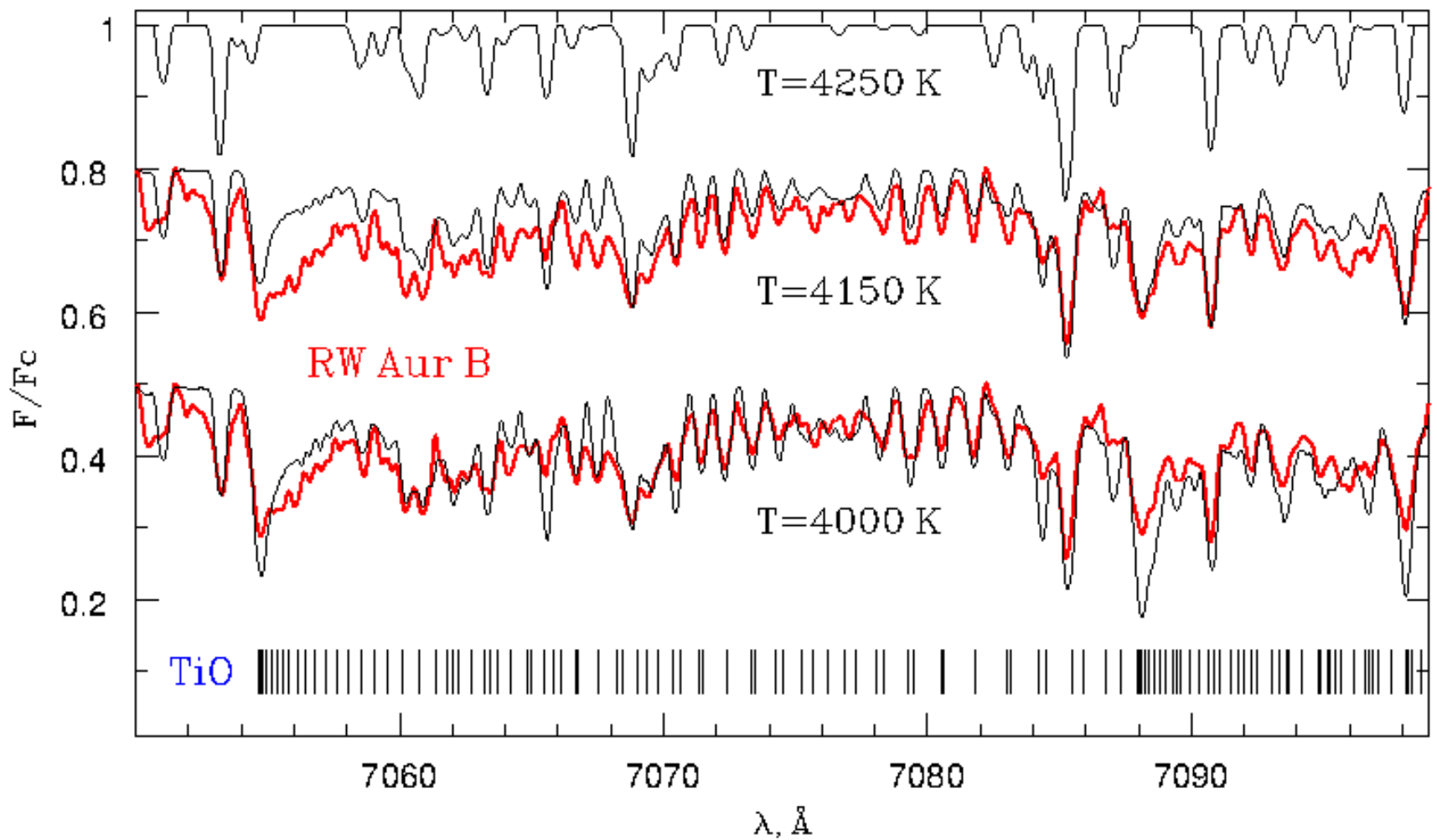
- When the star fades polarization increases (up to 3 % in V )
- PA orientation: disc scattering ?

## Conclusion 1

RW Aur B is UX Ori type star,

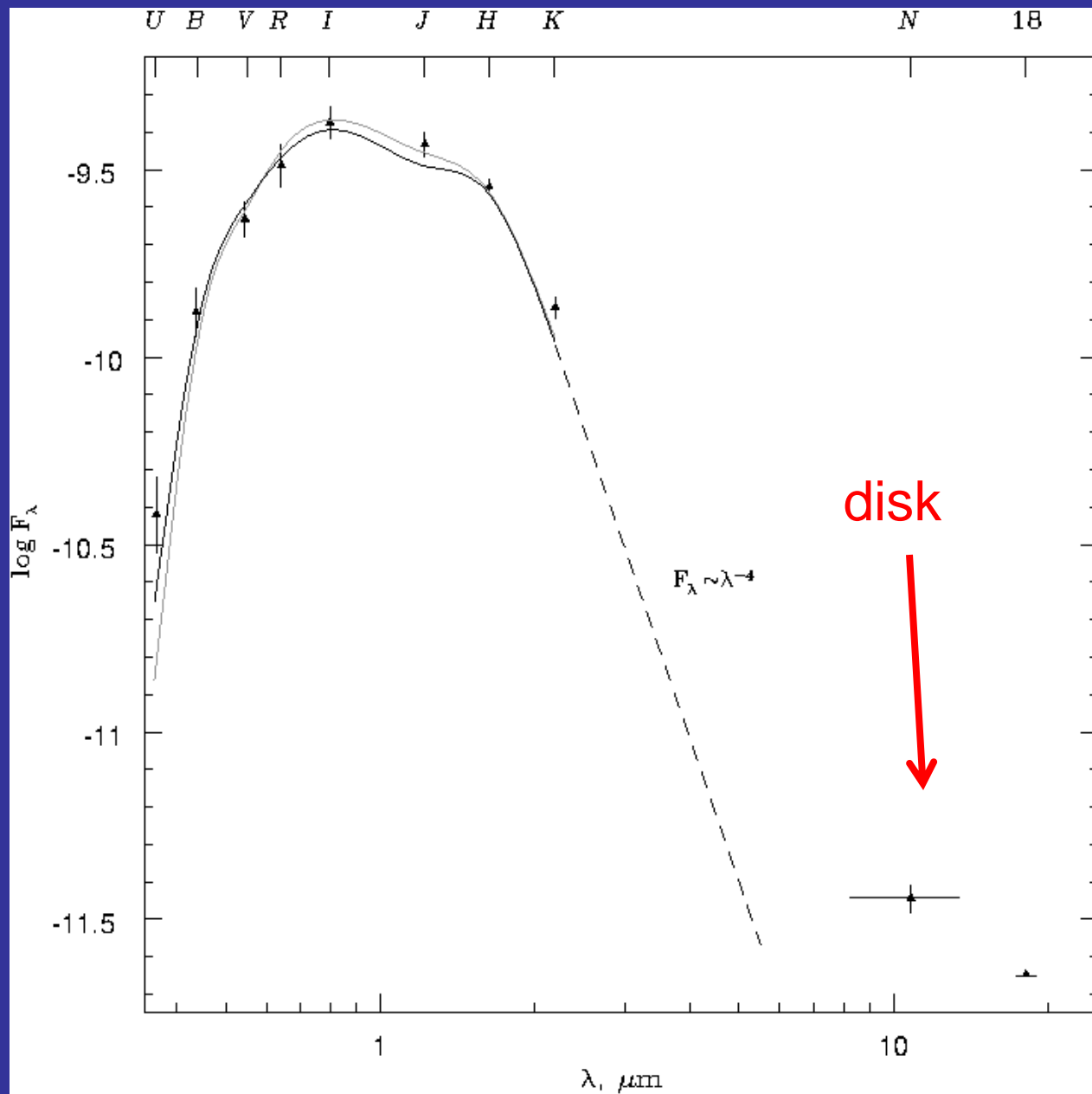
i.e. its photometric variability occurs due to eclipses by (gas-)dust clouds

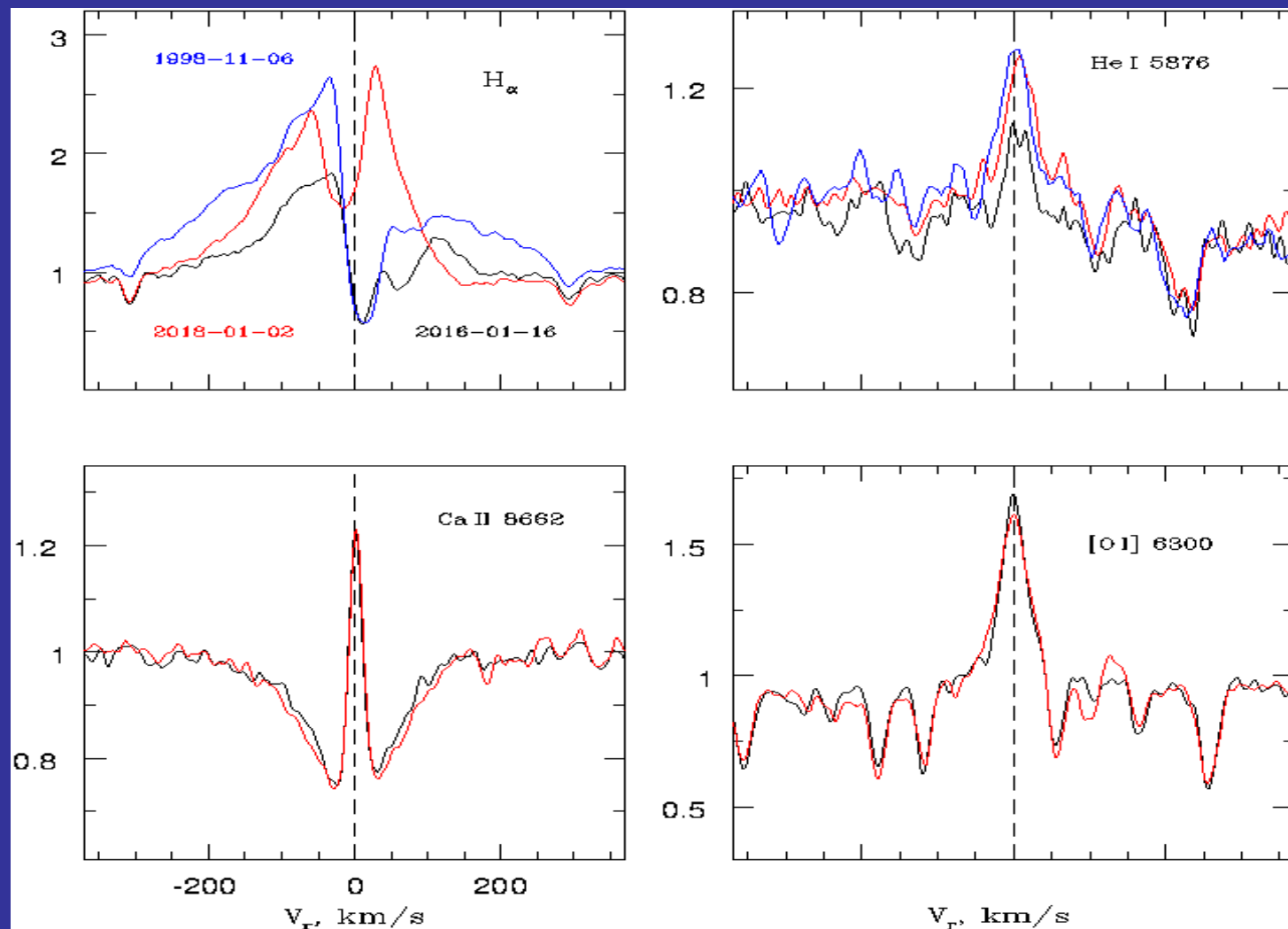
Dusty wind as in the case of RW Aur A ?  
Probably not...



$$T_{\text{eff}} \approx 4100 \pm 50 \text{ K}$$

# SED of RW Aur B

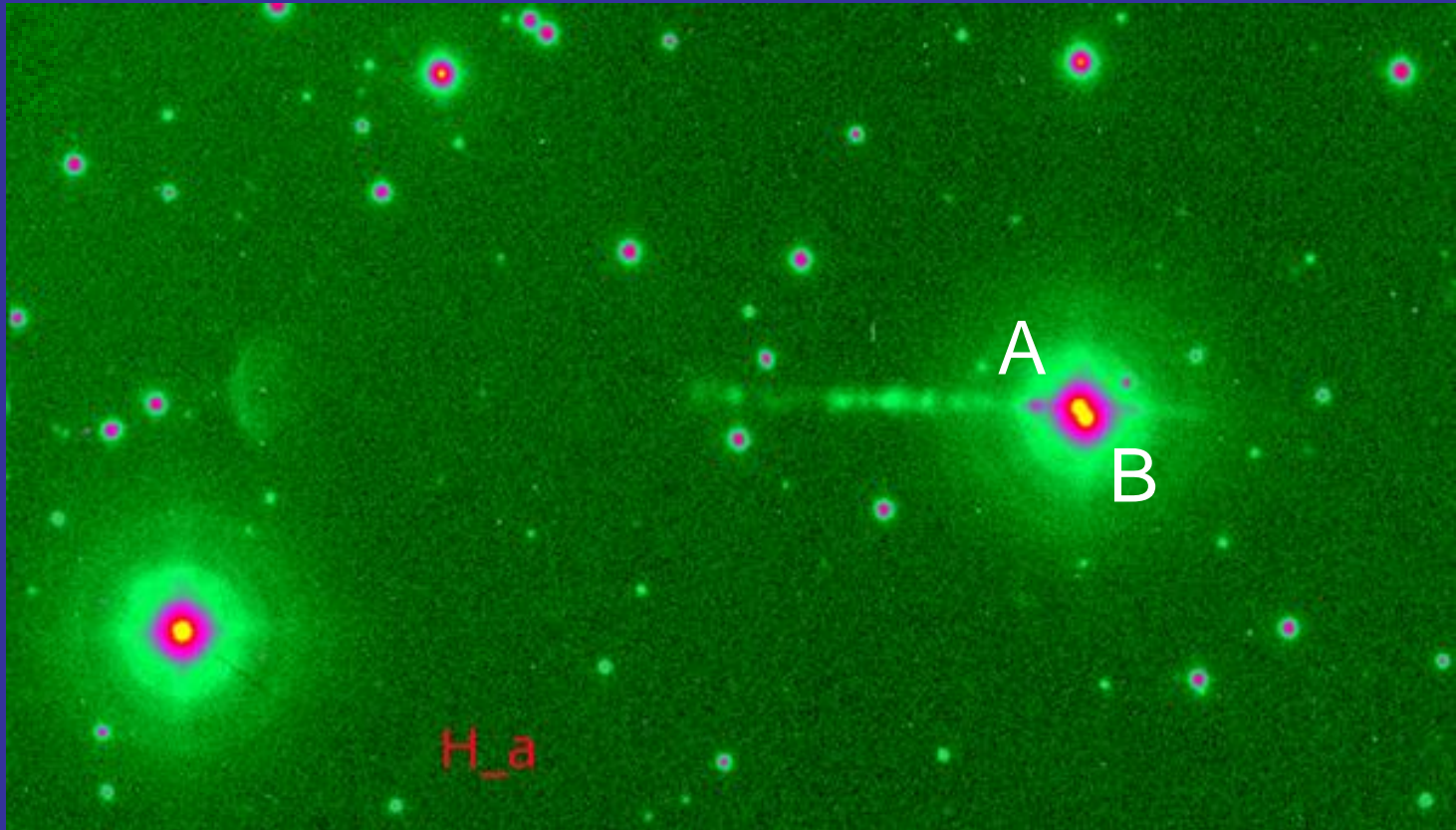




- 1) Accretion signatures in H Balmer lines.  $EW_{H\alpha} \approx 4 \text{ \AA}$  in our spectra, but *Duchene et al. (1999)* observed  $EW_{H\alpha} \approx 43 \text{ \AA}$ .
- 2) Powerful chromosphere in He I and Ca II lines;
- 3) No wind signatures -- e.g. [O I].



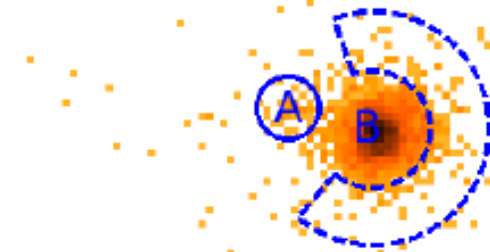
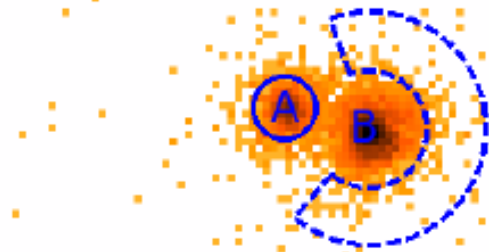
RW Aur B has no jet !



But why ???

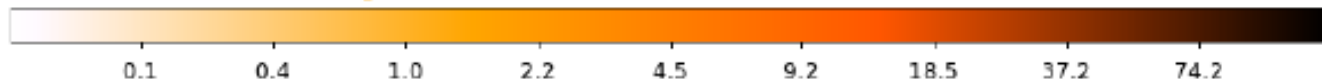
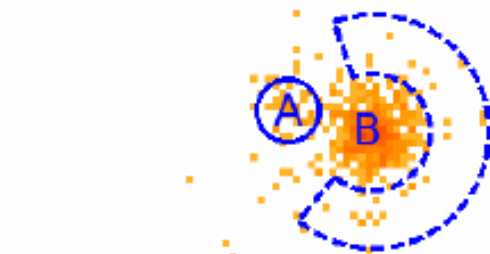
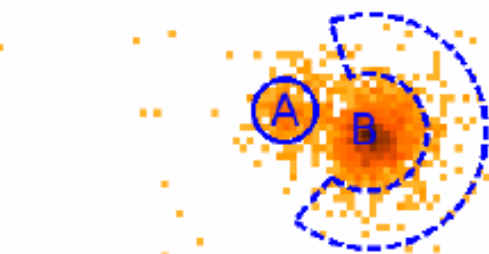
ObsID 14539 (2013)

ObsID 17644 (2015)



ObsID 17764 (2017)

ObsID 19980 (2017)



Gunter et al., 2018

RW Aur B:  $L_X \sim 10^{-3} L_{bol}$ ,  powerful corona

The star has magnetic field !?

3D MHD simulations of jet launching from disks in binary systems (Sheikhnezami & Fendt 2018) suggest a critical angle between disk plane and orbital plane of somewhat above 10 degrees beyond which a jet cannot persistently be formed out of a disk wind.

Wurster & Bate (2019) also found that bipolar outflows are launched in only 17 models out of 105, and these models have strong magnetic fields that are initially parallel to the rotation axis.

It supports the idea of Fendt & Zinnecker (1998) who consider a certain degree of axisymmetry as essential ingredient for jet launching.

*Rodriguez et al. (2018)* found that

$i \approx 56^\circ$  in the case of RW Aur A

$i \approx 68^\circ$  in the case of RW Aur B

i.e. the disks of A and B components misaligned by  $12^\circ$

## Conclusion 2:

Possibly RW Aur B has no jet due to relatively large inclination of inner regions of its disk to the orbital plane

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**Thank you for attention !**