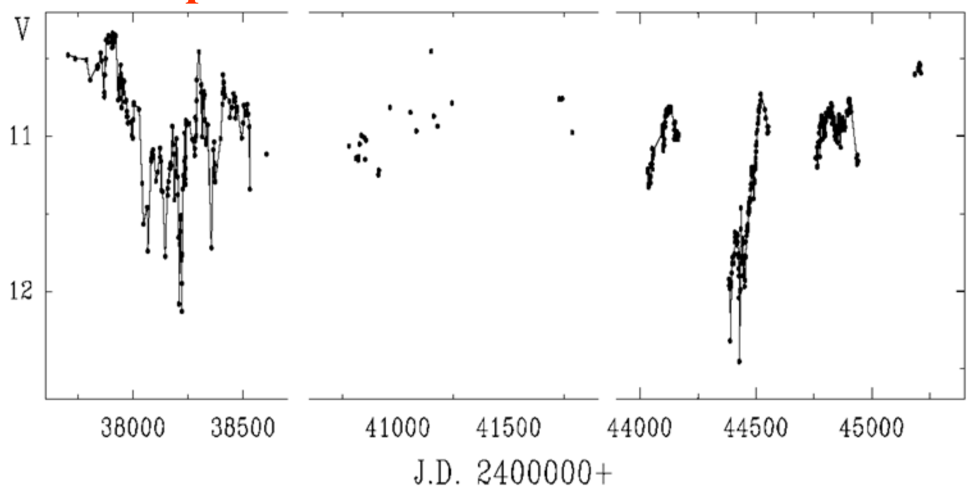
The UX Ori type activity in young cool stars

Vladimir Grinin

Pulkovo Observatory of RAS,
St.-Petersburg University

SV Cep



The Wonders of Star Formation

Edinburg 2018

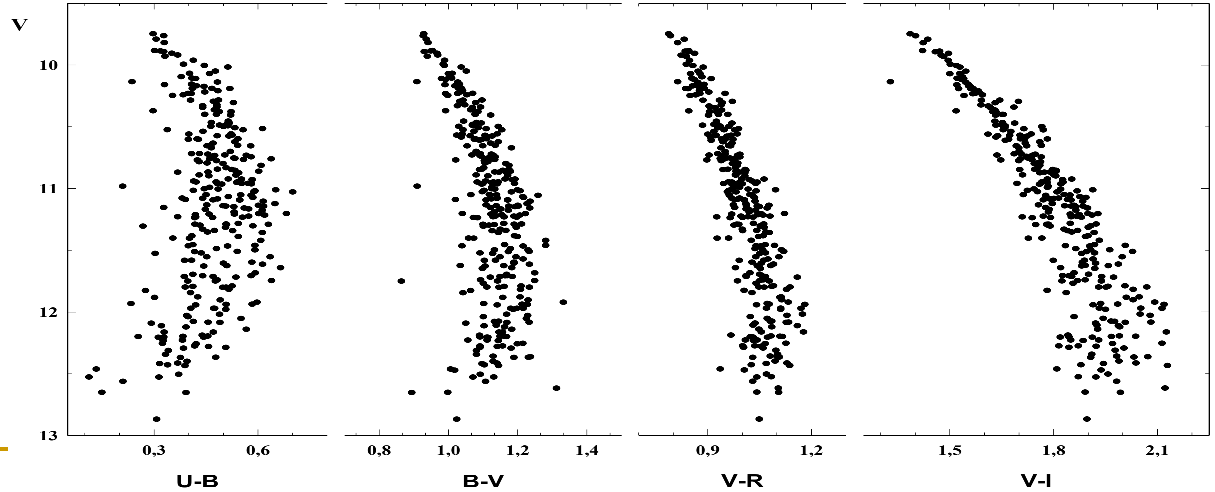
The main observational properties

The UXOR family: HAEs + small amount of TTSs

Large-amplitude (up to 3^ m) sporadic minima, typical duration: few days – few weeks

The "*blueing effect*" : Goetz and Wenzel (1968) – CQ Tau

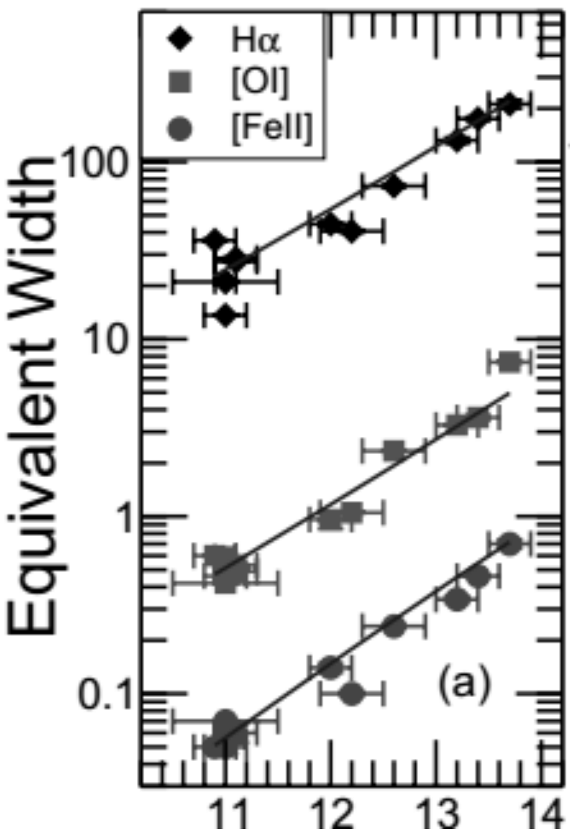
CO Ori, Rostopchina et al. 2007

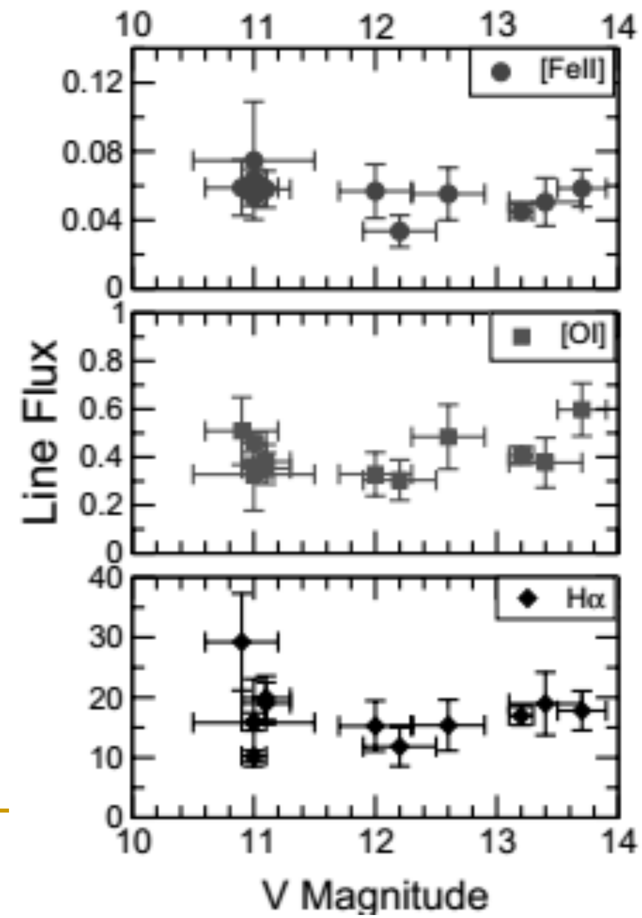


Spectral variations

EW(Hα) increases in deep minima, the Hα flux decreases (Kolotilov 1977; Herbst et al. 1983; Rodgers et al. 2002, etc)

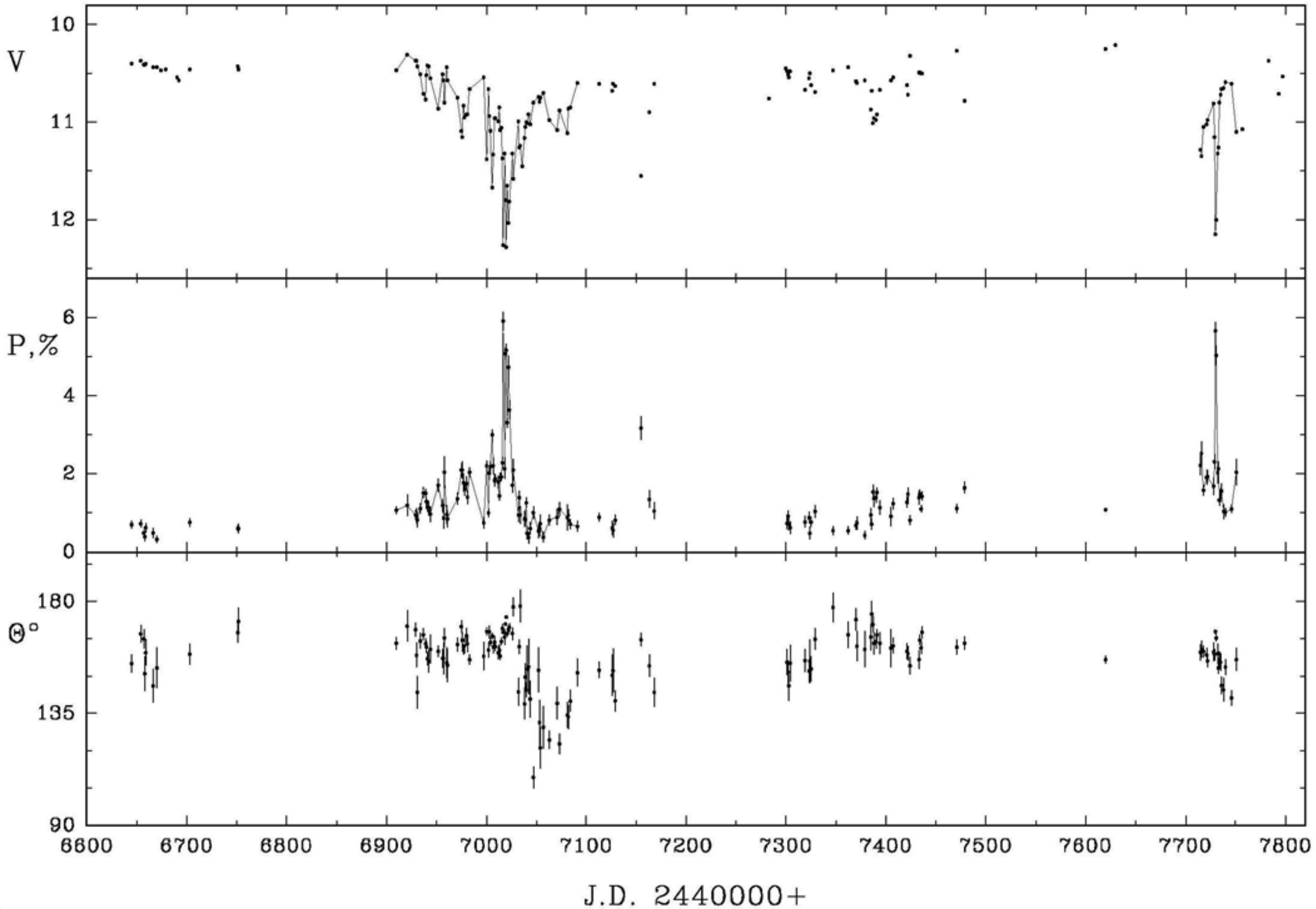
RR Tau **Rodgers + 2002**





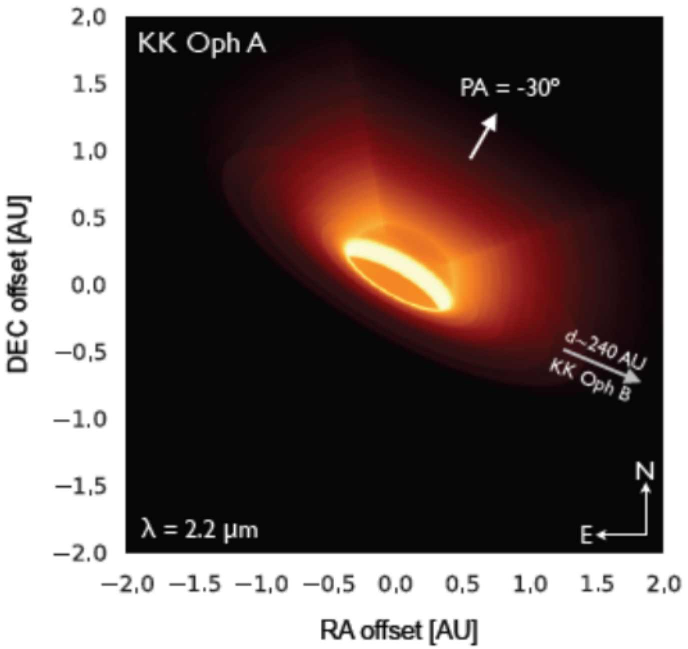
Polarimetric response - coronagraphic effect - - small inclination of CS disks to the LOS

WW Vul Grinin +1988; Berdyugin + 1991

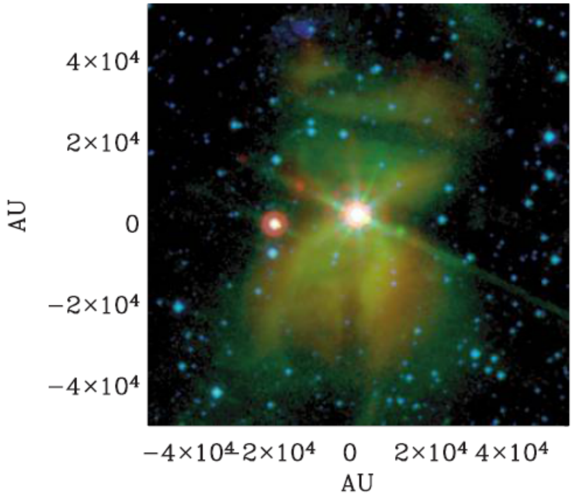


Confirmation from interferometric observations:

Kreplin + (2013): KK Oph *i* = 70 deg.
---//---- + (2016): UX Ori 70



VV Ser, Pontoppidan 2007



CO Ori, Davies, + 2017
***i* = 30 deg. Disk wind?**

P.A. of the intrinsic LP coincides with the P.A. of the minor axis of CS discs

Shadows on the disks

HD 135344B
Stolker et al. 2017

The face-on version of the UX Ori phenomenon:
the variable shadows on the disk images (J band)

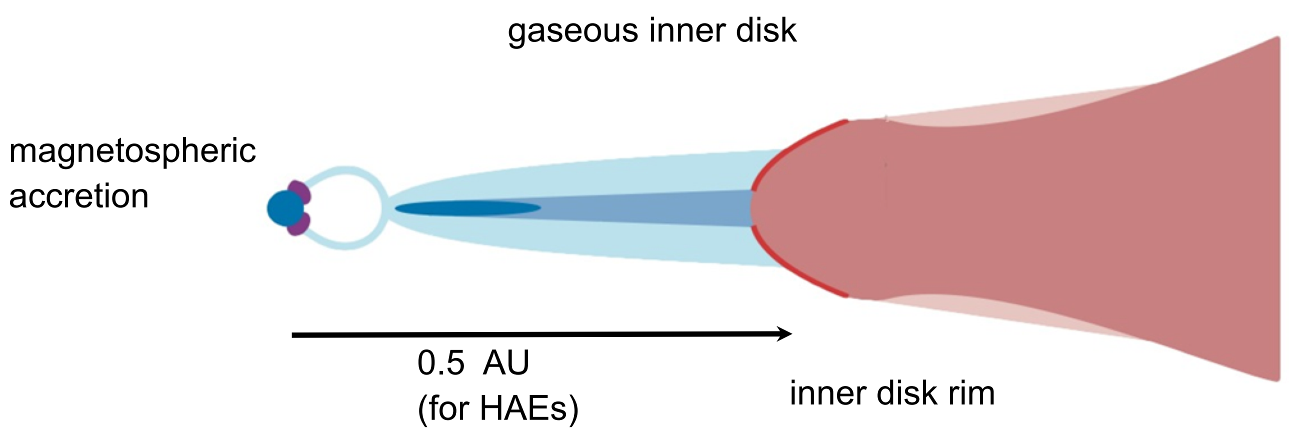
The more power shadows has to be observed
on the disk images of T Tauri stars and the well known TTS
HH 30 is an example of such an object (e.g. Watson & Stapelfeldt 2007) `

The structure of the inner CS disc

- Dust-free inner hole
- Puffed-up inner rim (Natta et al. 2001)

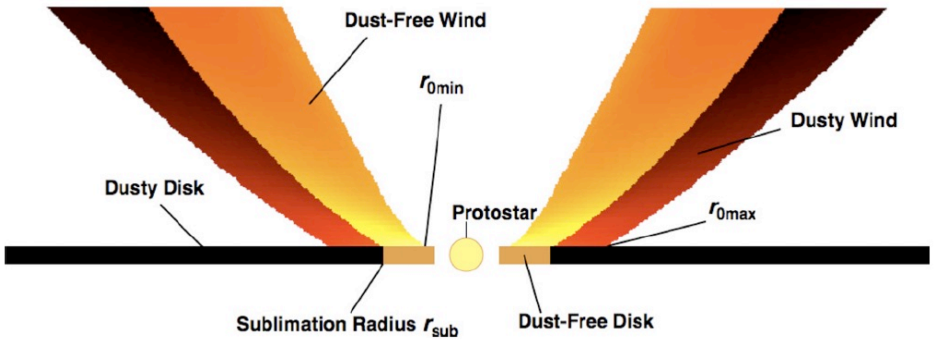
Fluctuations of CS extinction near the evaporation zone

Tsub = 1600 K



From DM 2010

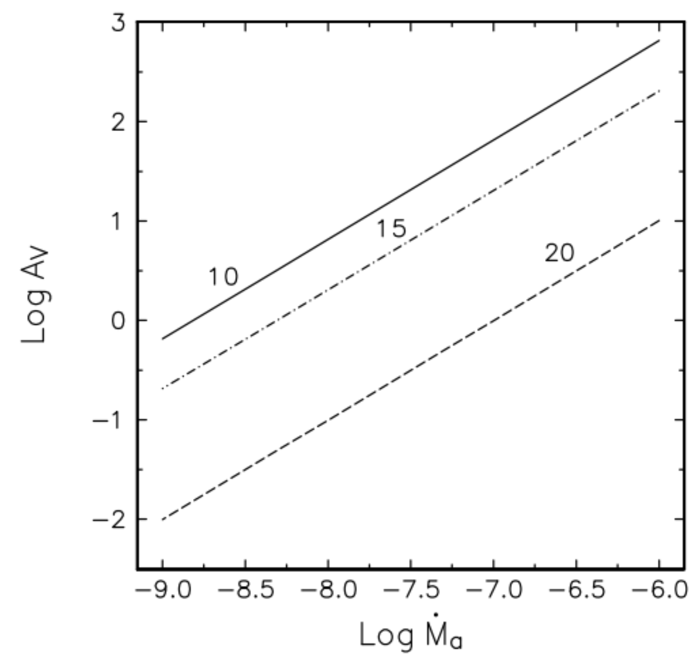
Dusty disk wind as a source of variable CS extinction (more important in TTSs than in HAEs)



Tambovtseva & Grinin, 2008

Safier 1993

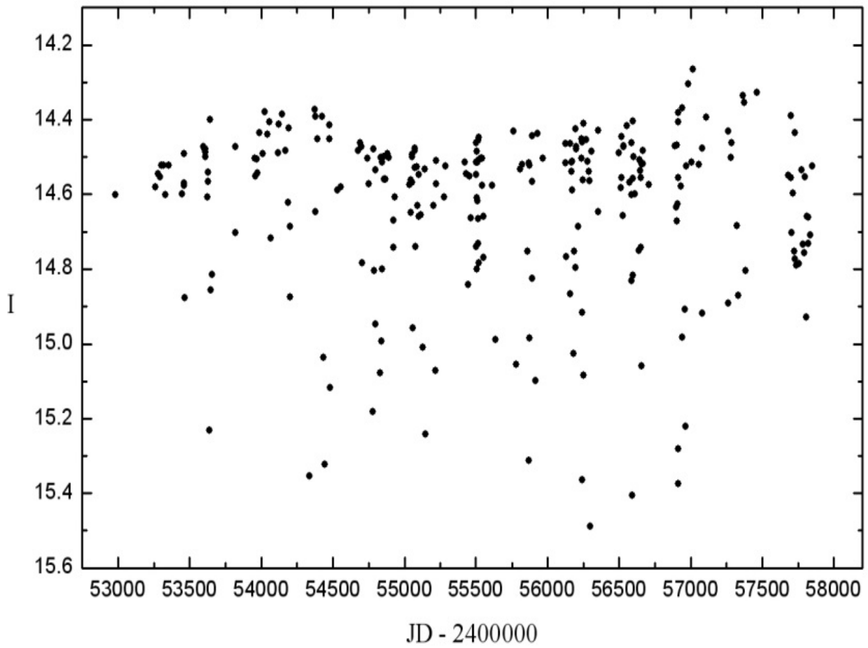
Vinkovi´c & Jurki´c 2007
Bans & Konigl, 2012



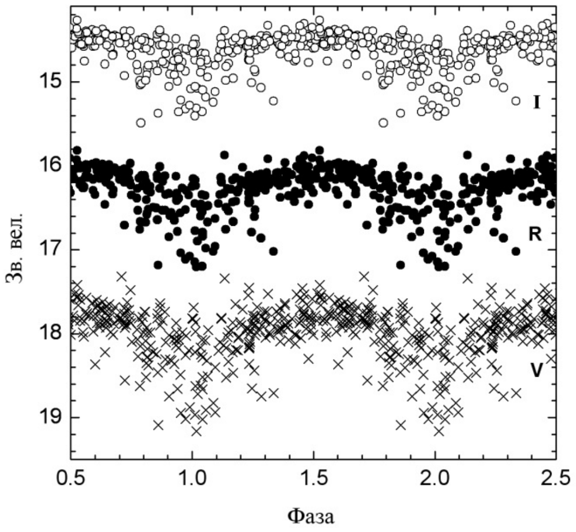
The cool part of the UXOr family

Combination of the AA Tau and UXOR activity

V695 Per   Sp = M3.75 , WTTS, Barsunova +, 2015



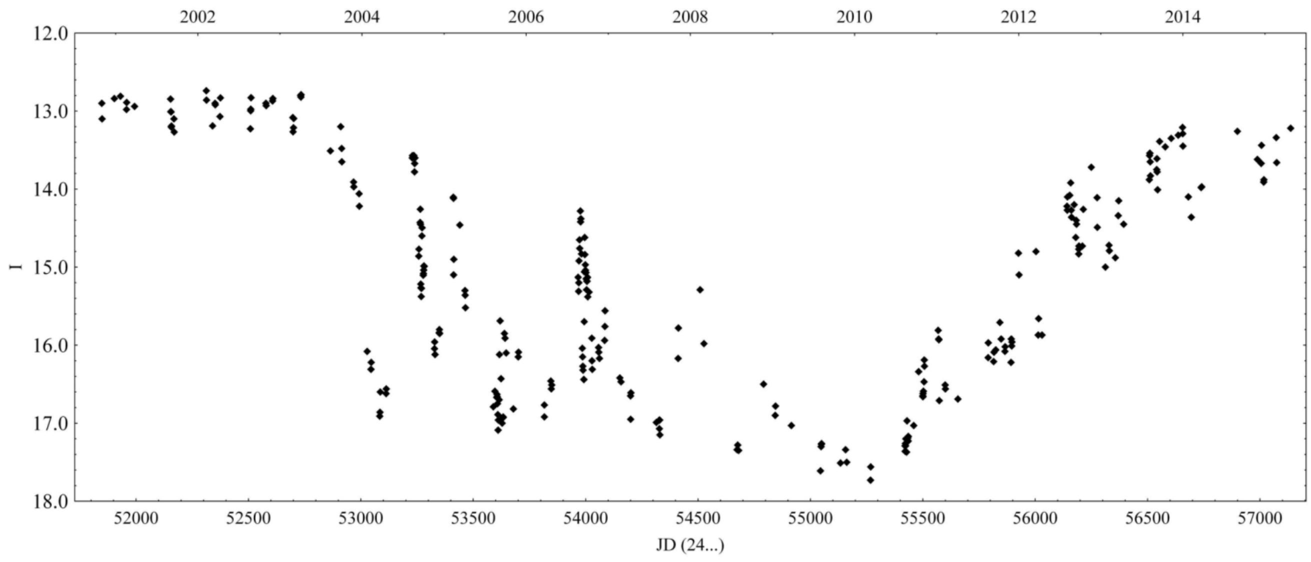
P = 7.6 d



UXOR as a temporary phase in the life of PMS star

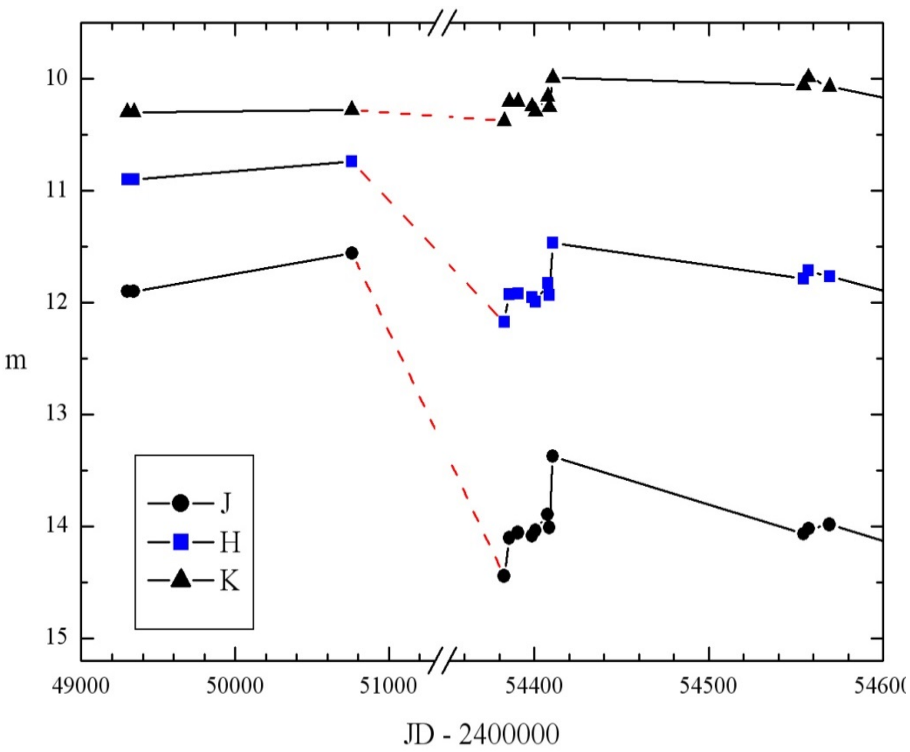
V1184 Tau, Sp = G5, III-IV , WTTS

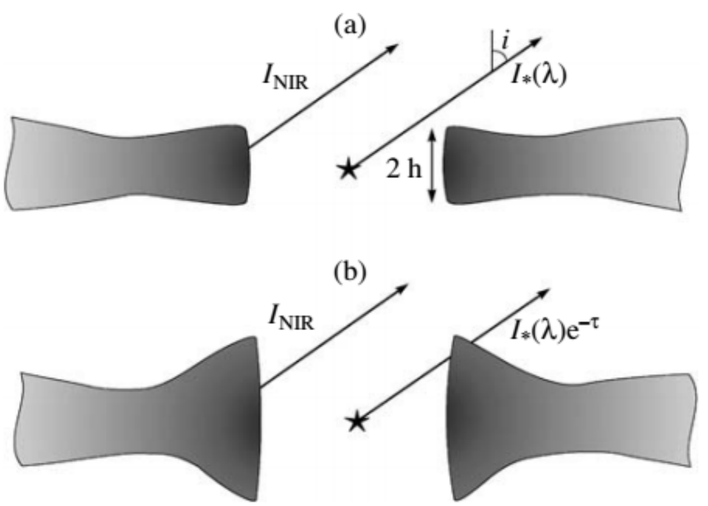
The light curve of **V1184 Tau,** Semkov +2015



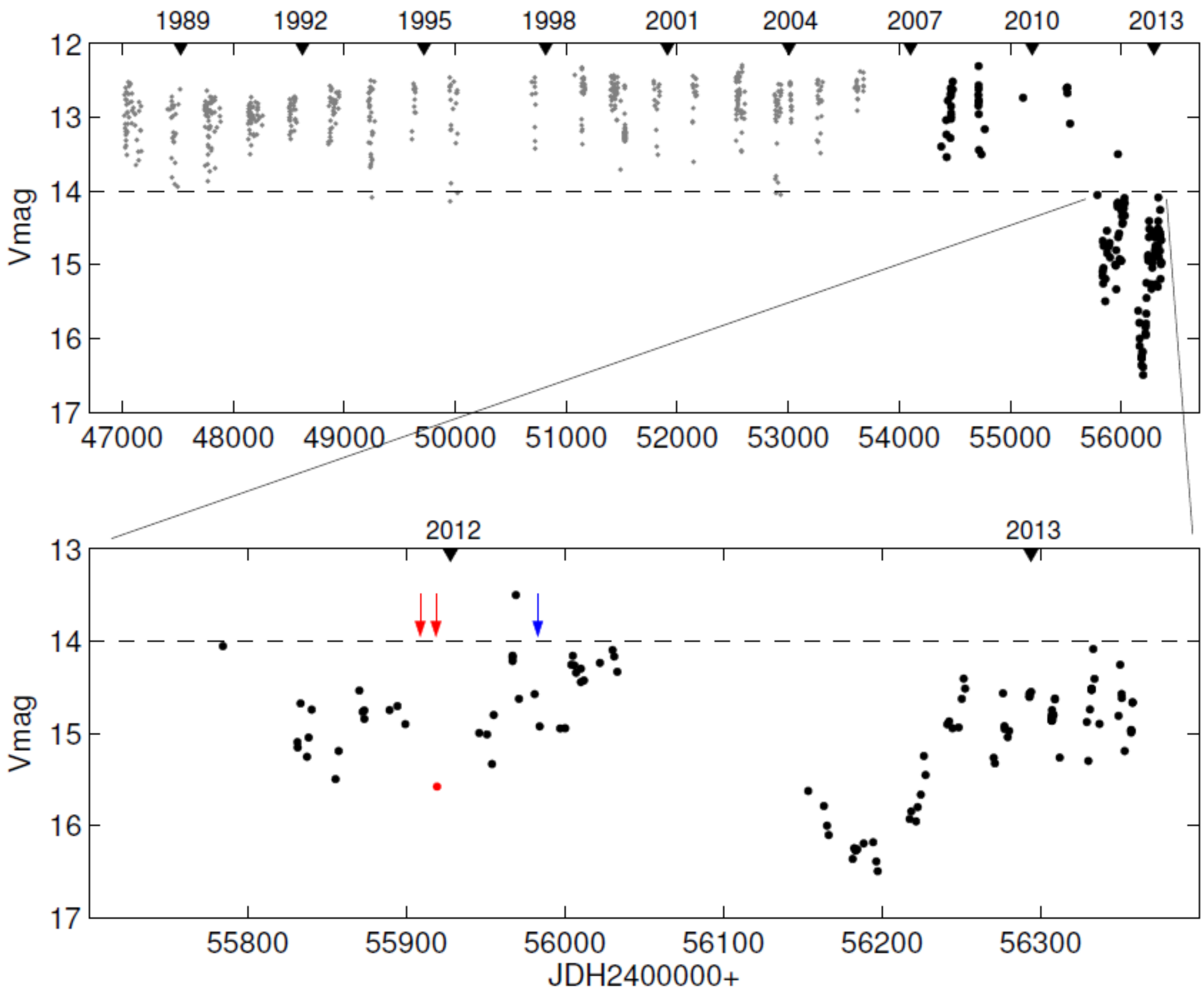
Appearance of the large amount of dust in the star vicinity can be considered as a direct evidence for the large episodic accretion event (Grinin et al. 2009). (See also Audard + 2013).

V1184 Tau, JHK light curves
Grinin +, 2009, see also Giannini et al. 2016



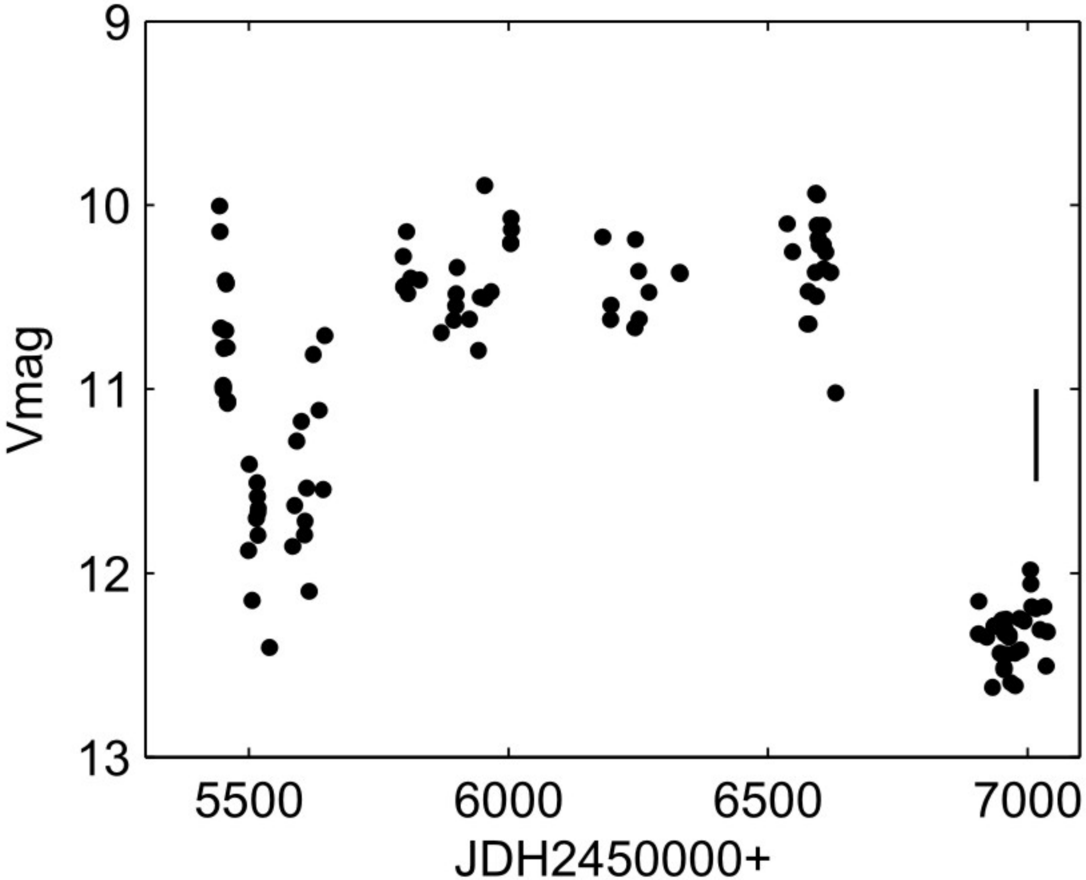


AA Tau, Bouvier, Grankin et al. 2015



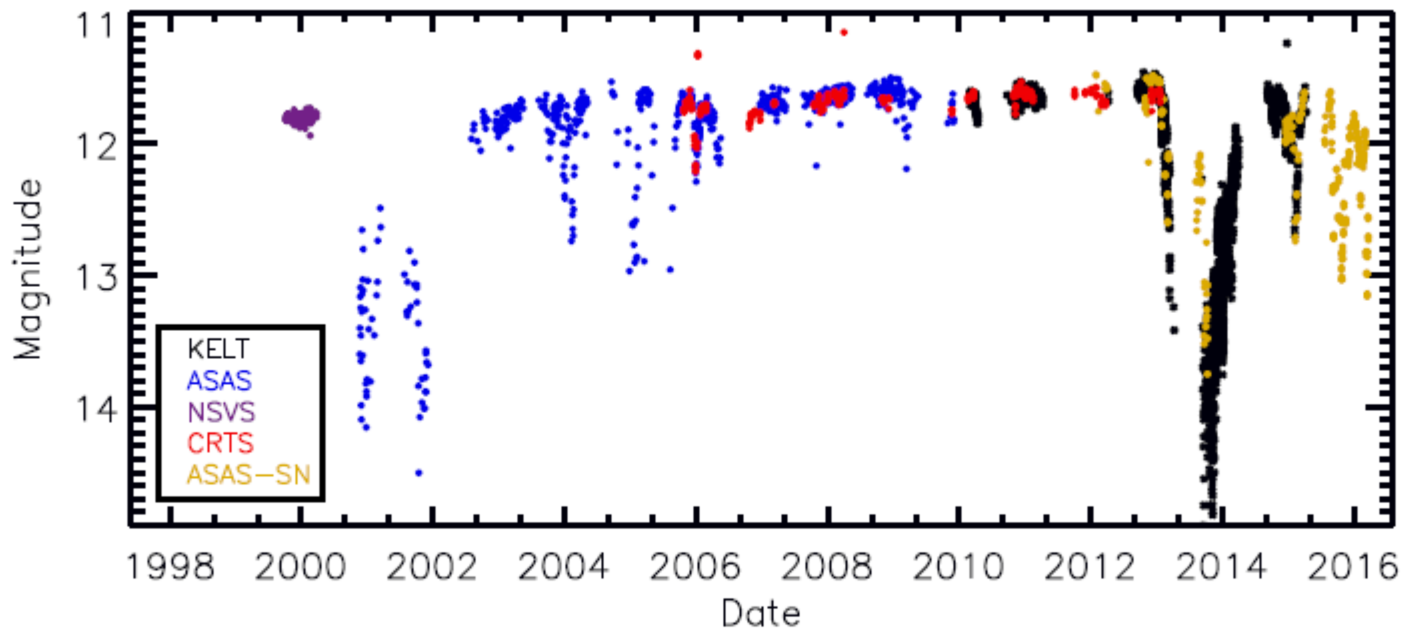
UX Ori phenomenon among TTSs

RW Aur, CTTS , Petrov + 2015, Lamzin + 2017



The dusty disk wind

DM Ori , Sp = G, **Rodriguez + 2016**

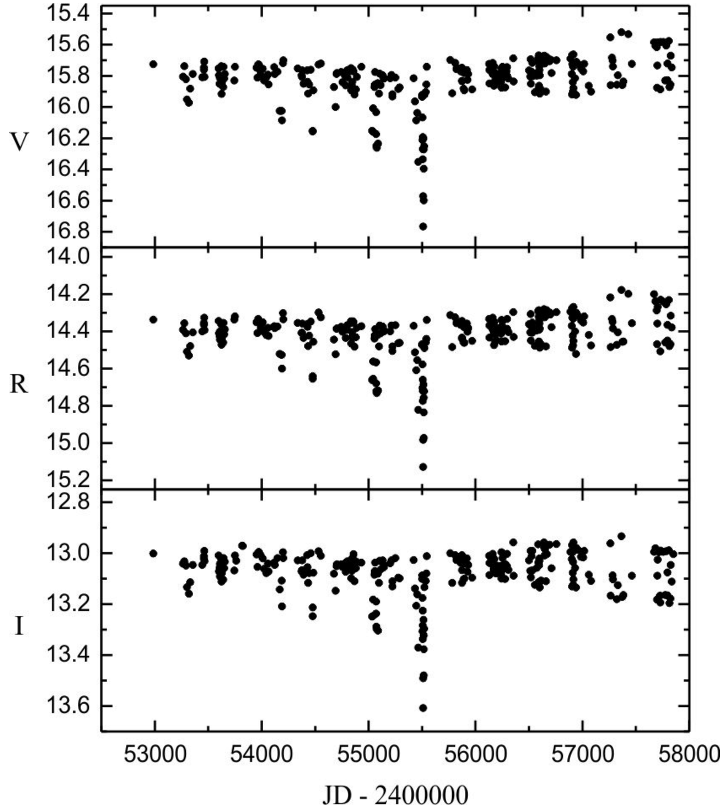


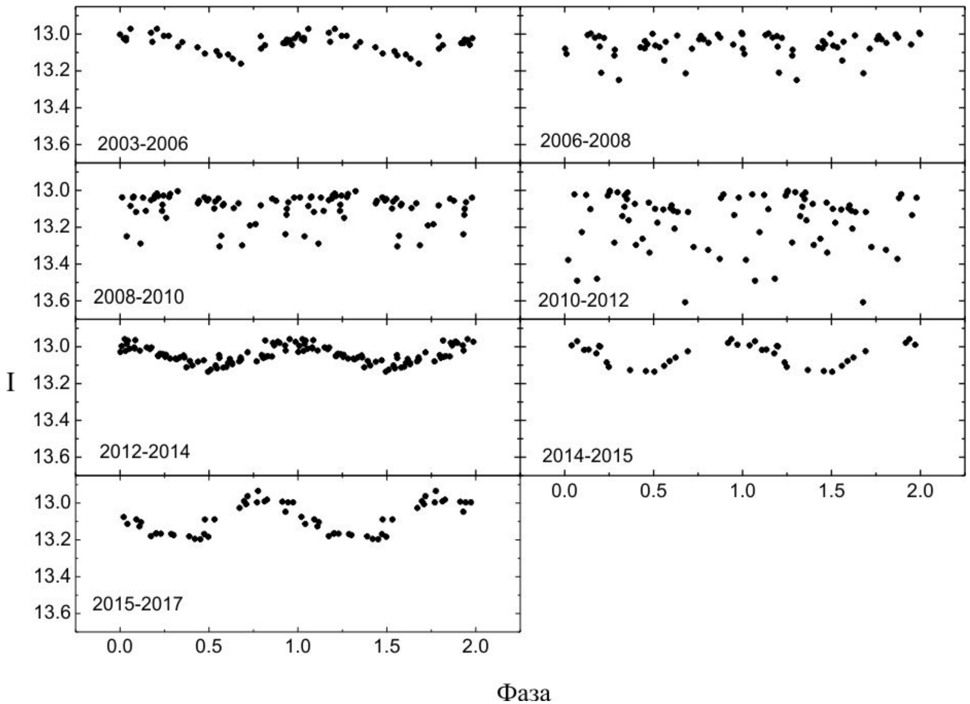
12.5 yrs

It may indicate a disturbance which can be caused by a protoplanet

V715 Per, Sp = K6, WTTS , Grinin + 2018;
The UXOR + AA Tau variability

P = 5.23 d





RZ Psc (KO IV, WTTS) – UXOR

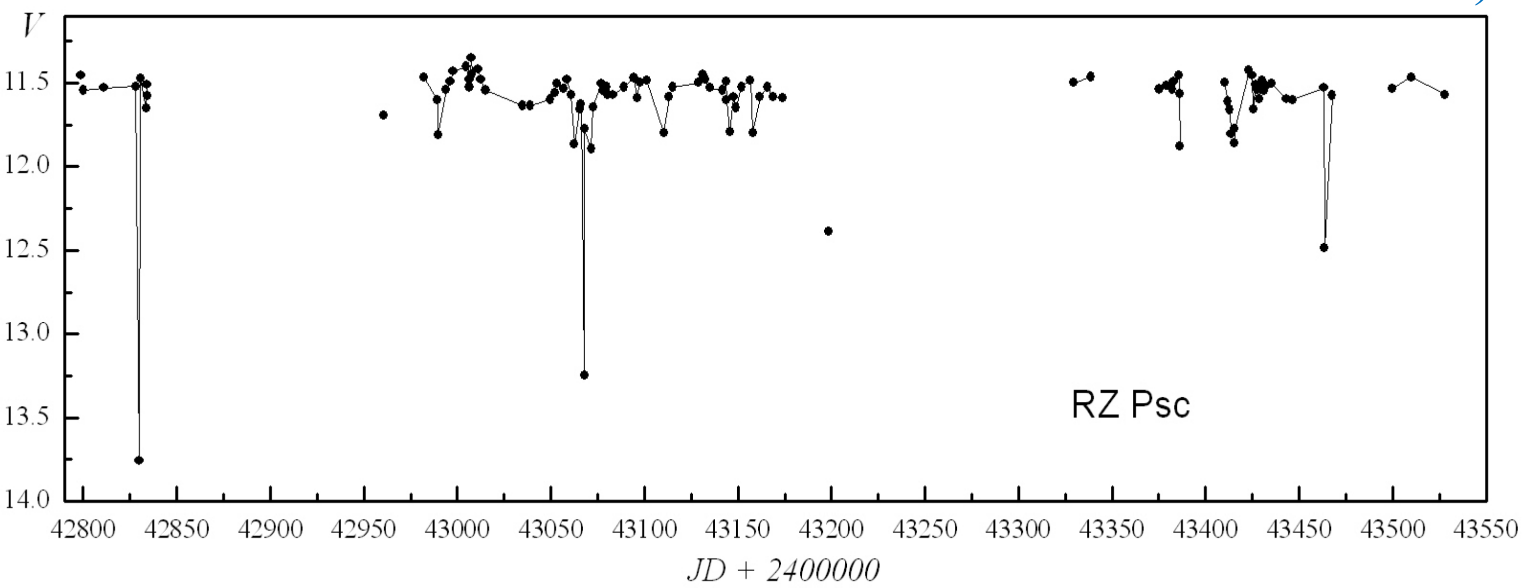
Age ~ 20-30 Myr (Grinin + 2010; Potravnov + 2013

IR excess, de Wit et al. 2013

Tdust = 500 K, R in = 0.4-0.7 AU

Duration of the deep minima: $\Delta t \leq 2-3d$

Zaitseva 1985)

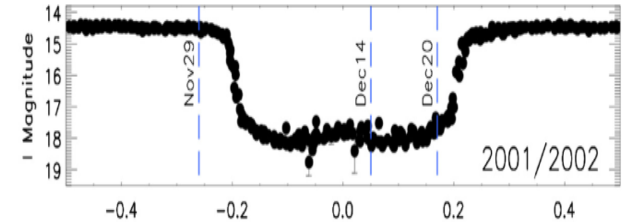


dV/dt = 0.1/ hr

Mass of the dust clumps ~ few 10^20 g.

D ~ 0.6 AU

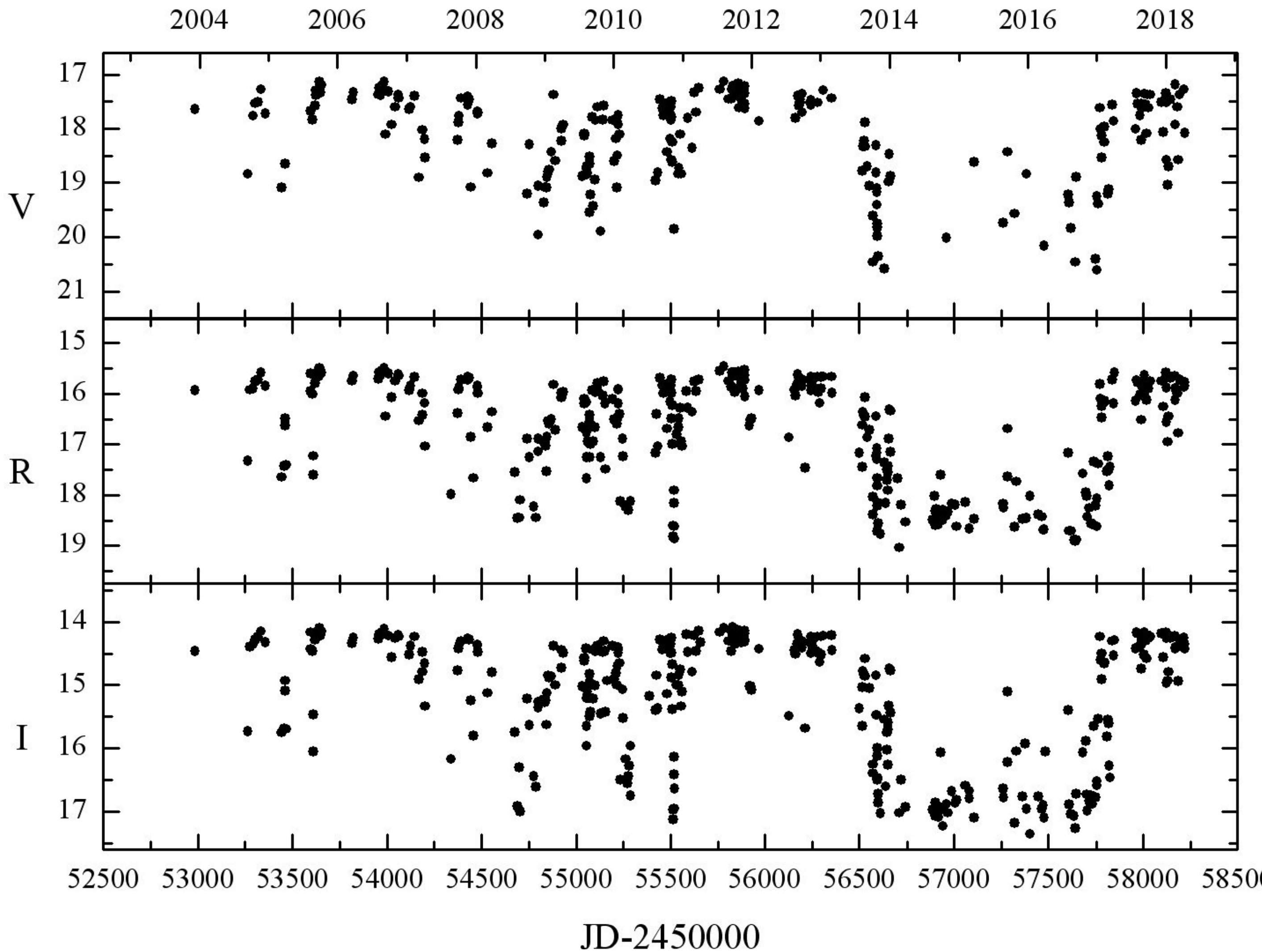
KH 15D , Hamilton + 2012



?

V719 Per, WTTS, Sp = M1.25

Barsunova +, in` preparation



Conclusion

1. The cool UXOrs demonstrate a bigger variety of light curves and extinction events. The combination of AA Tau and UXOR variability is the wide spread phenomenon

3. The dusty disk wind plays an important role in the organization of the extinction events, more important than in the hot UXORs.

3. The coordinated optical and IR photometry + spectroscopic observations are needed for better understanding the nature of the non-stationary processes in the nearest environment of young stars/

Thank you!