

On the origin of continuum and line emission in CTTs

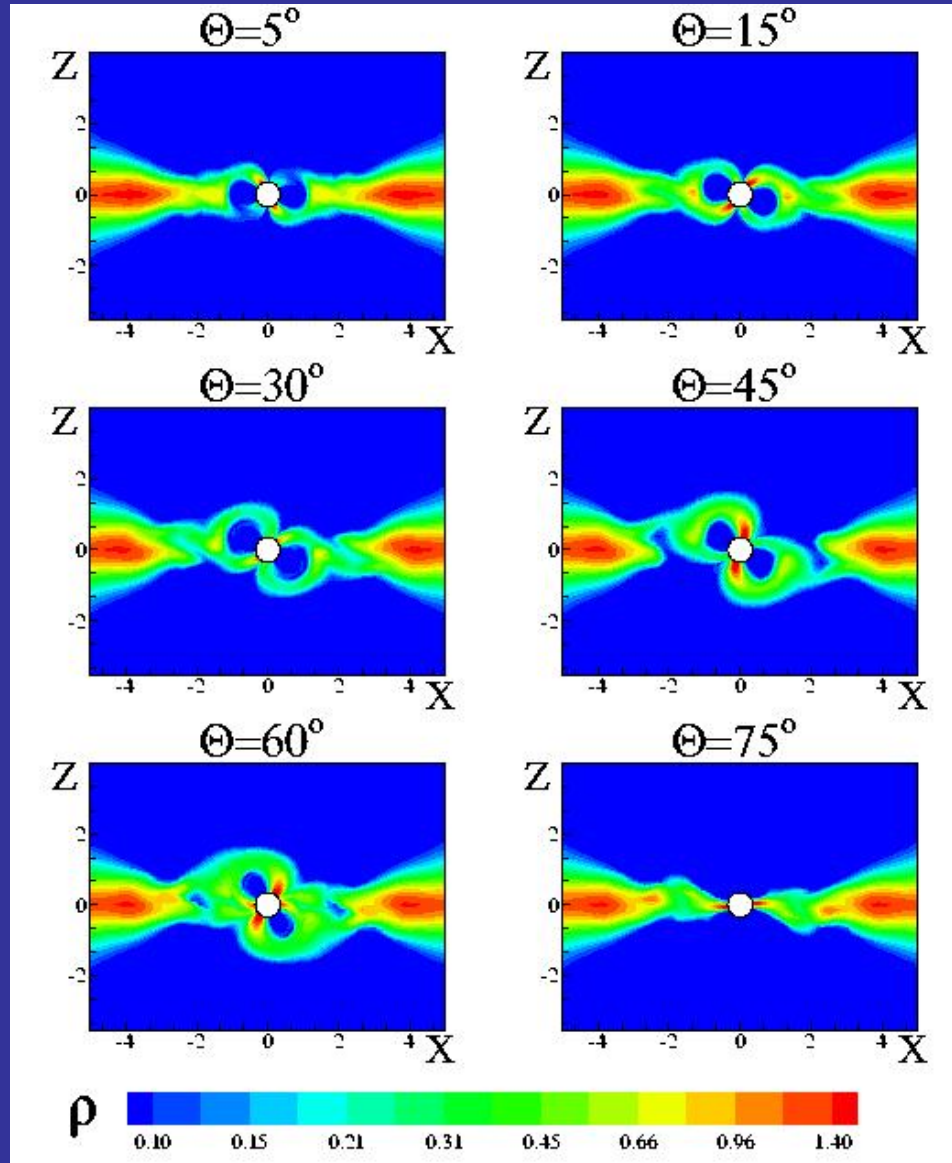
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Disk accretion onto inclined dipol

Romanova et al., ApJ 595, 1009 (2003)



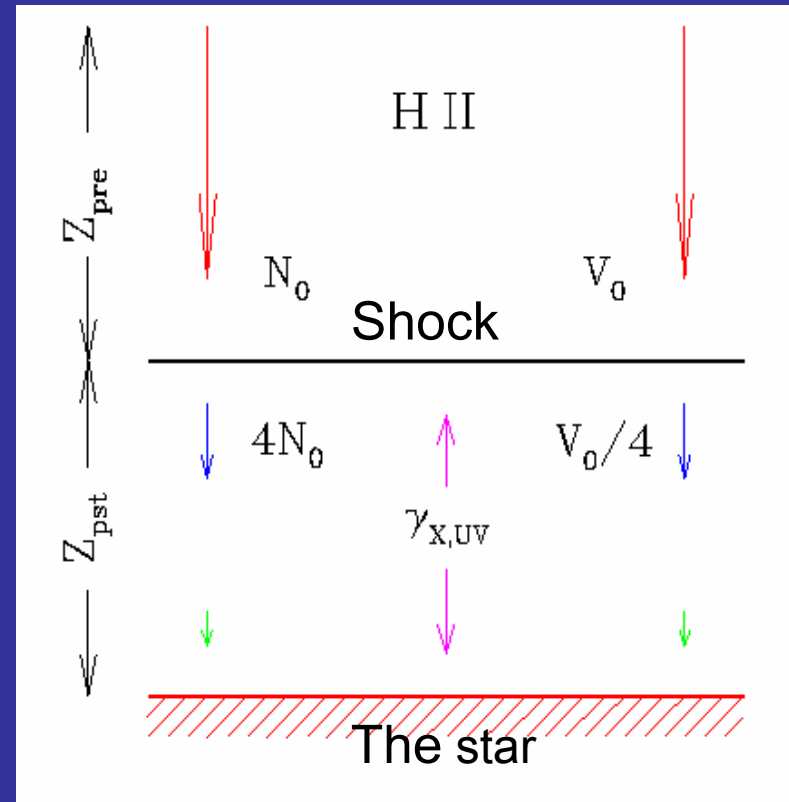
Schematic structure of accretion shock in CTTs

(Lamzin 1995, 1998; Calvet & Gullbring 1998)

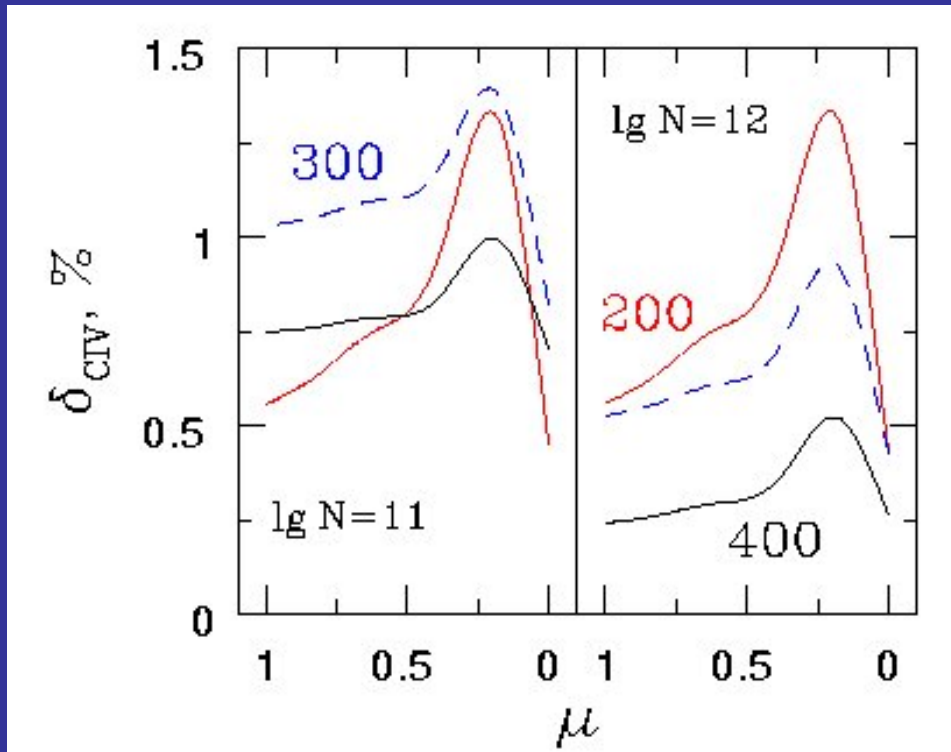
It was shown that:

- $V_0 \in 200 \div 400$ km/s, $N_0 \in 10^{11} \div 10^{13}$ cm⁻³
- $Z_{\text{pre}} \text{ и } Z_{\text{pst}} \ll R_*$ \longrightarrow AS can be considered as plane-parallel

Dynamical and thermal times are much less than observed time of lines & continuum variability (hours) \longrightarrow AS can be considered as quasystationary.



Relative intensities of CIV 1550 doublet lines



Star	$F_{\text{CIV}} / F_{\text{cont}}$
RY Tau	0.002 %
DR Tau	0.003 %
T Tau	0.02 %
DG Tau	0.07 %
DS Tau	0.2 %
BP Tau	0.4 %
Theory	~ 1 %

Kravtsova & Lamzin (2003, 2004)

Velocity field near surface of CTTS

Observed flux ratio \ll than calculated one.
*The conclusion doesn't depend on uncertainty
of A_V and extinction law $A_\lambda(\lambda)$!*



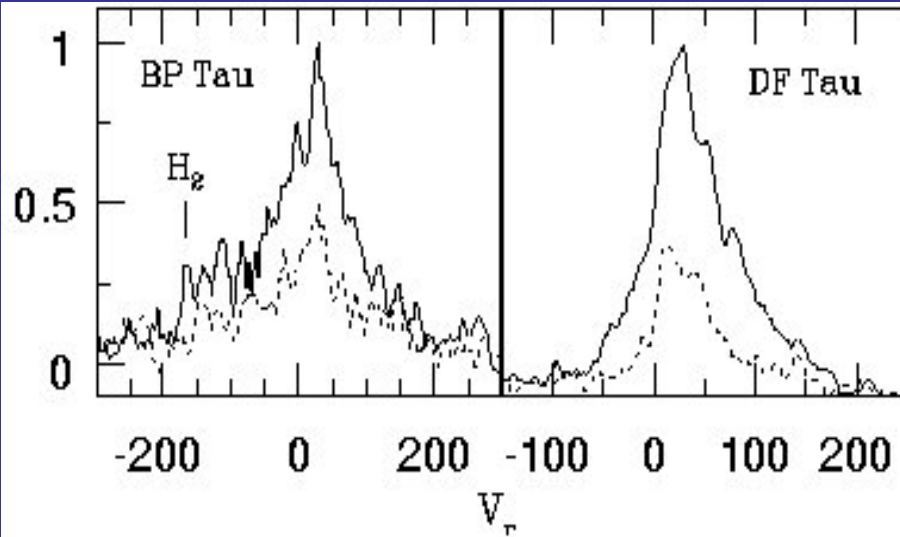
The main portion of veiling continuum
originates outside CIV 1550 line formation
region, i.e. outside accretion shock.



The main portion of accreted matter doesn't pass
through accretion shock, i.e. falls to the star almost
parallel to stellar surface.

Resonant lines of Li- and Na-like ions

(Lamzin, 2003, *Astron. Rep.* 47, p.498 & p.540)



We calculated profiles i.e. $I_\nu = I(N_0, V_0, \nu, \mu)$ of **C IV 1550**, **N V 1240**, **O VI 1035** & **Si IV 1400** doublet lines in 1-D accretion shock. (full frequency redistribution in the flow with non-zero velocity gradient)

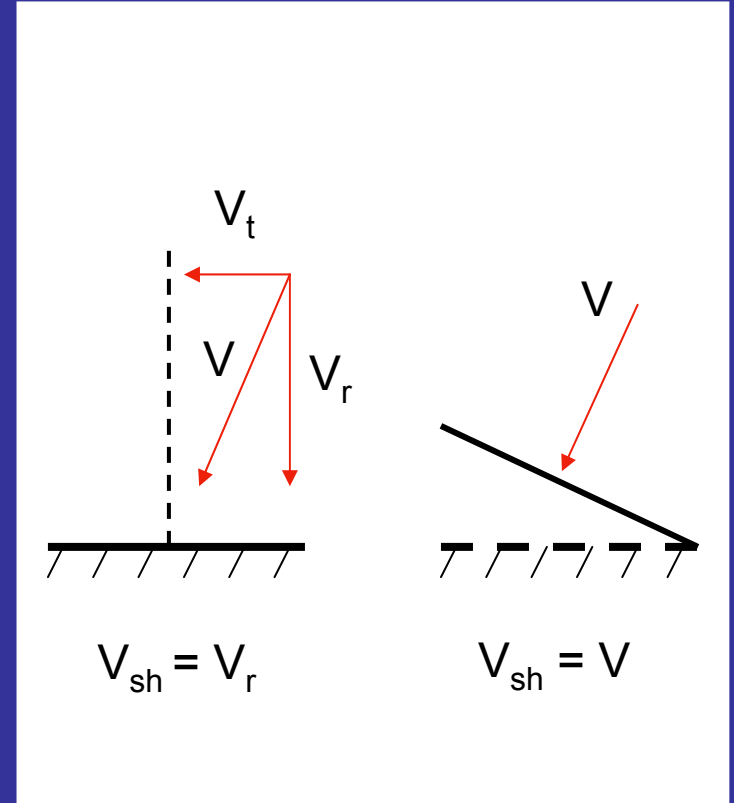
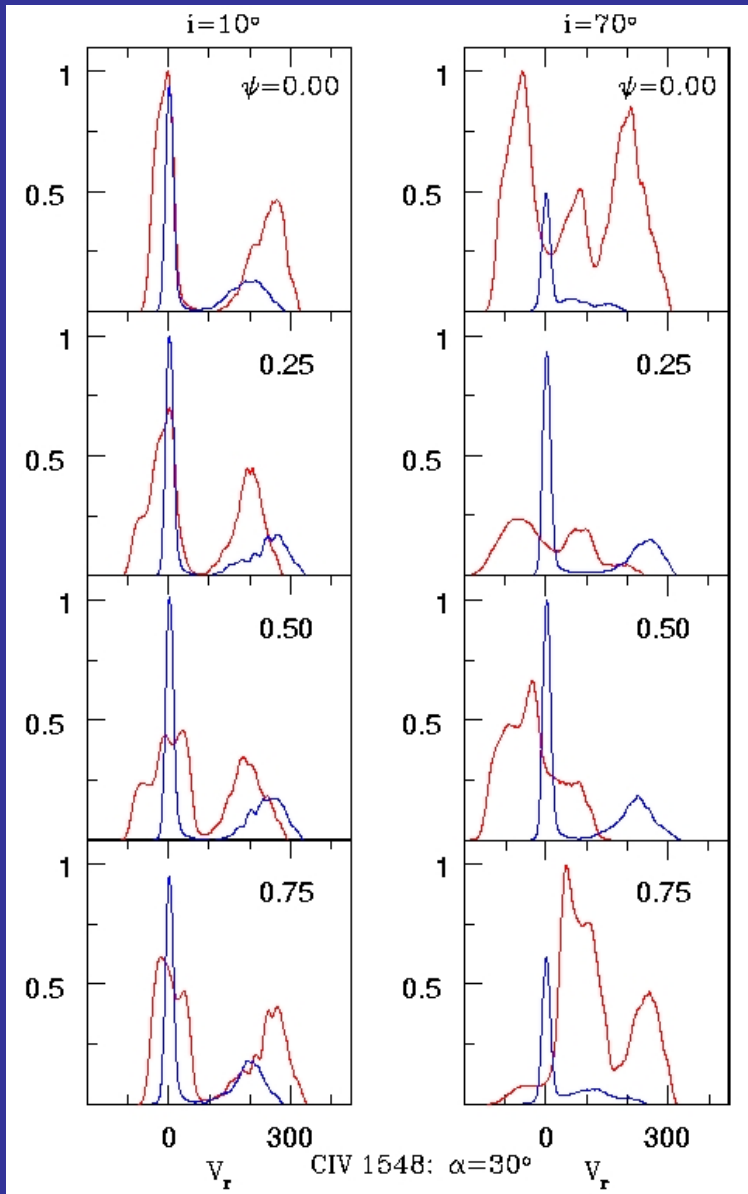
- C IV 1550 lines have the largest intensity: $L_{\text{CIV}} \sim 0.01 L_{\text{bol}}^{\text{Shock}}$
- The lines form in two regions of accretion shock \Rightarrow double peaked structure

Profiles were calculated assuming that accretion is

- 1) **radial**
 - 2) **homogeneous**
 - 3) accretion zone looks like a **spot** or **spherical belt**.
- Theoretical profiles differ strongly from observed ones probably because accreted gas velocity \mathbf{v} has tangential component $V_t \sim 30\text{-}50 \text{ km/c}$?

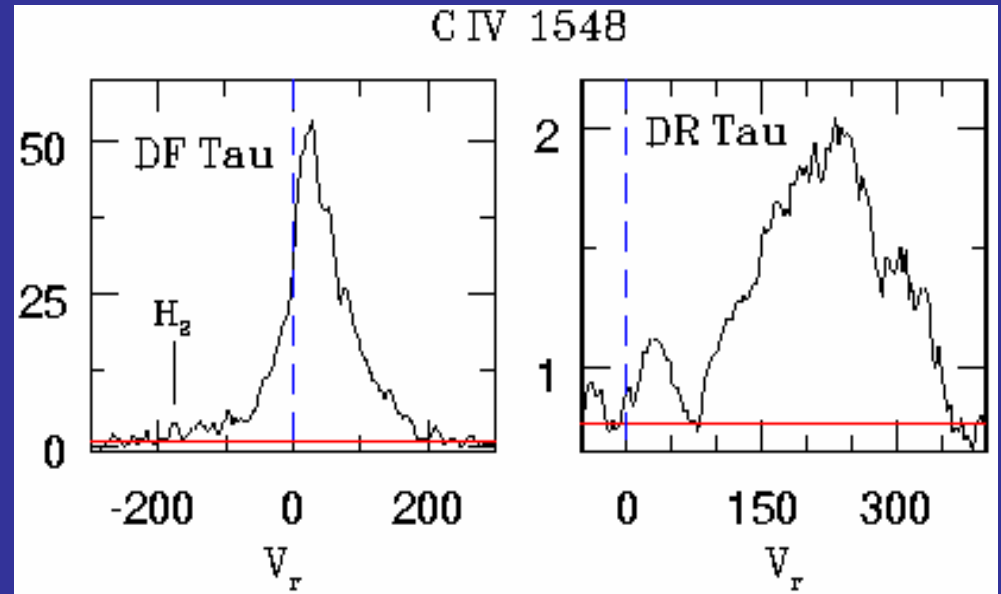
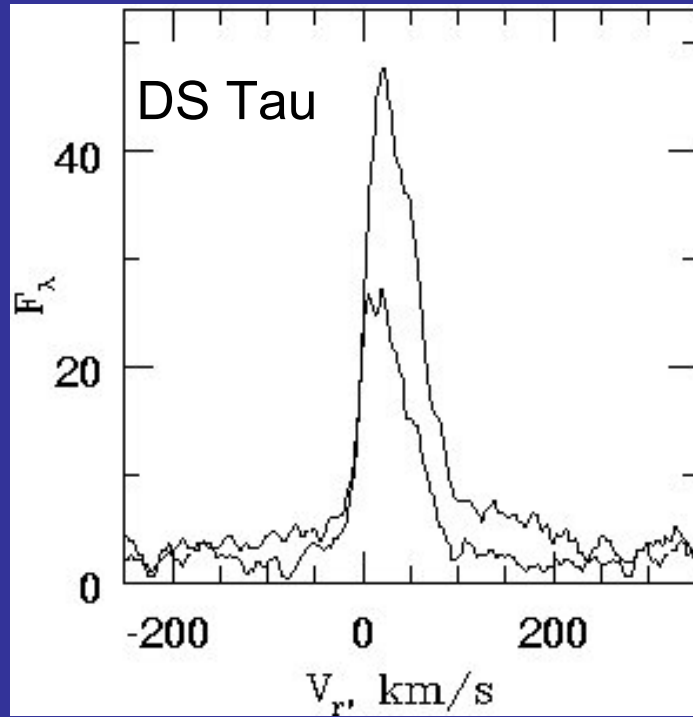
Magnetic field of CTTs is strongly non-dipole near stellar surface?

Calculated profiles of CIV 1550 doublet lines

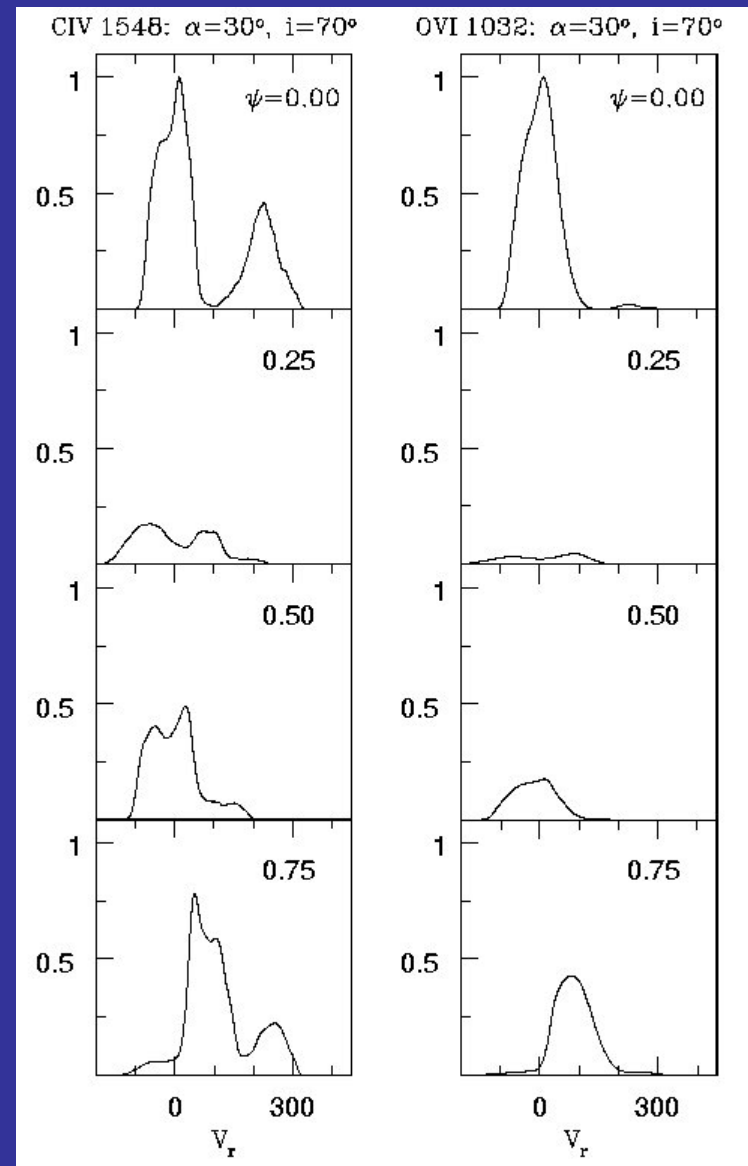
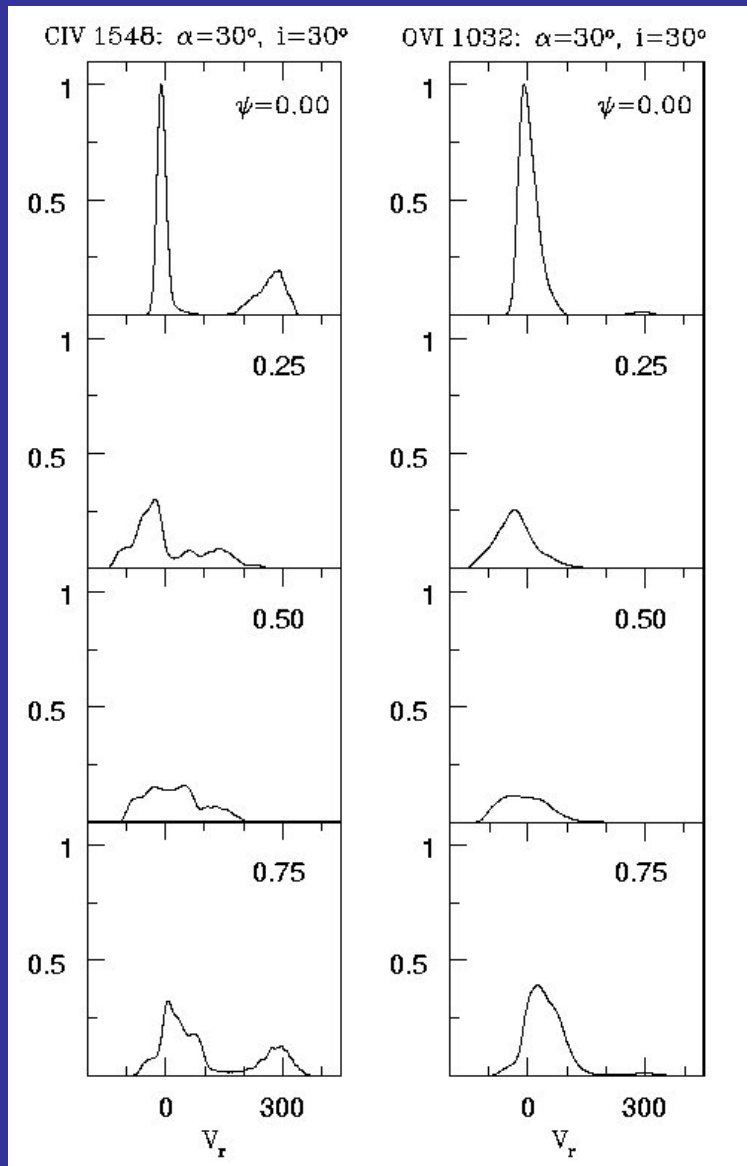


— $V_{sh} = V$
 — $V_{sh} = V_r$

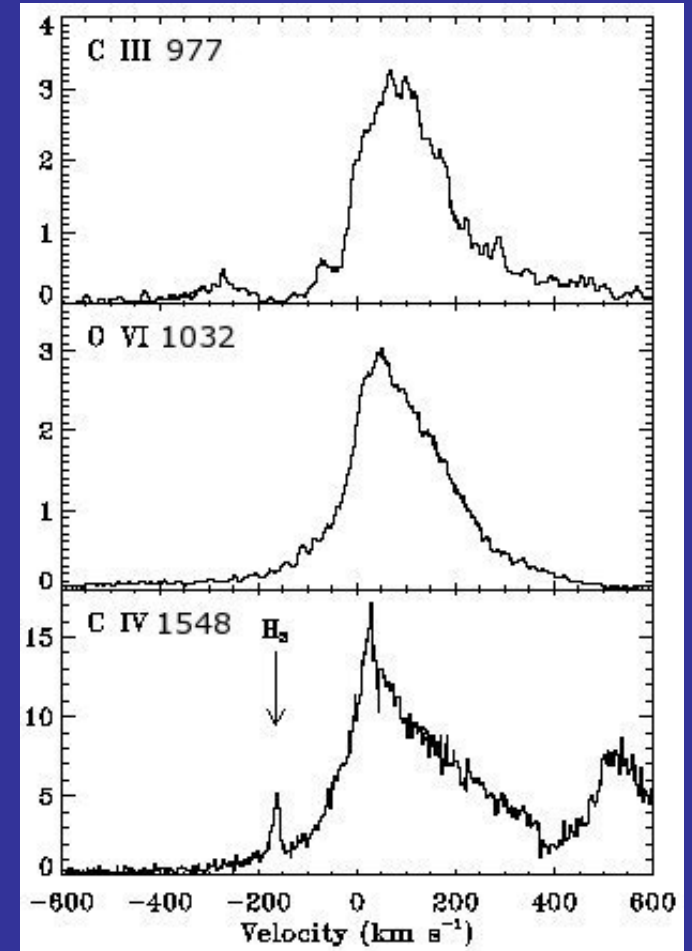
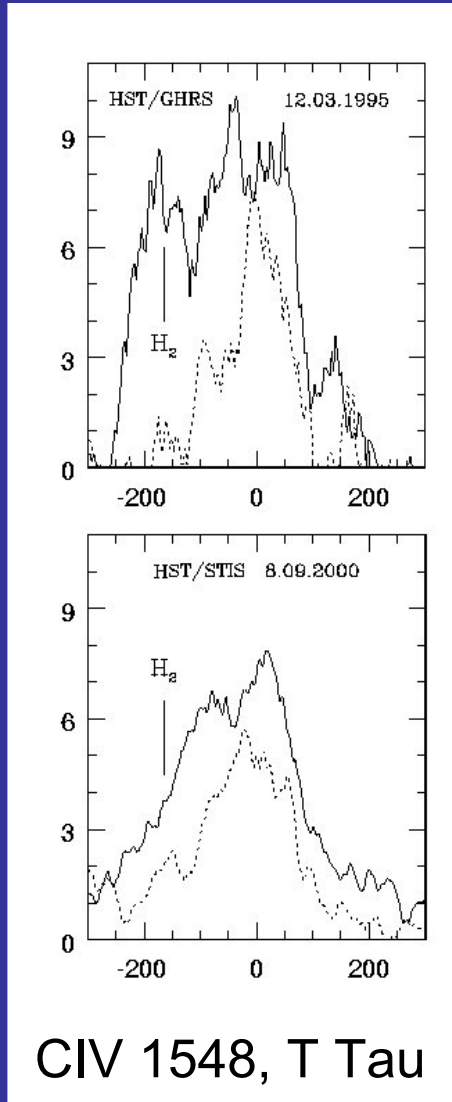
Observed profiles of CIV 1550 doublet lines in CTTs spectra



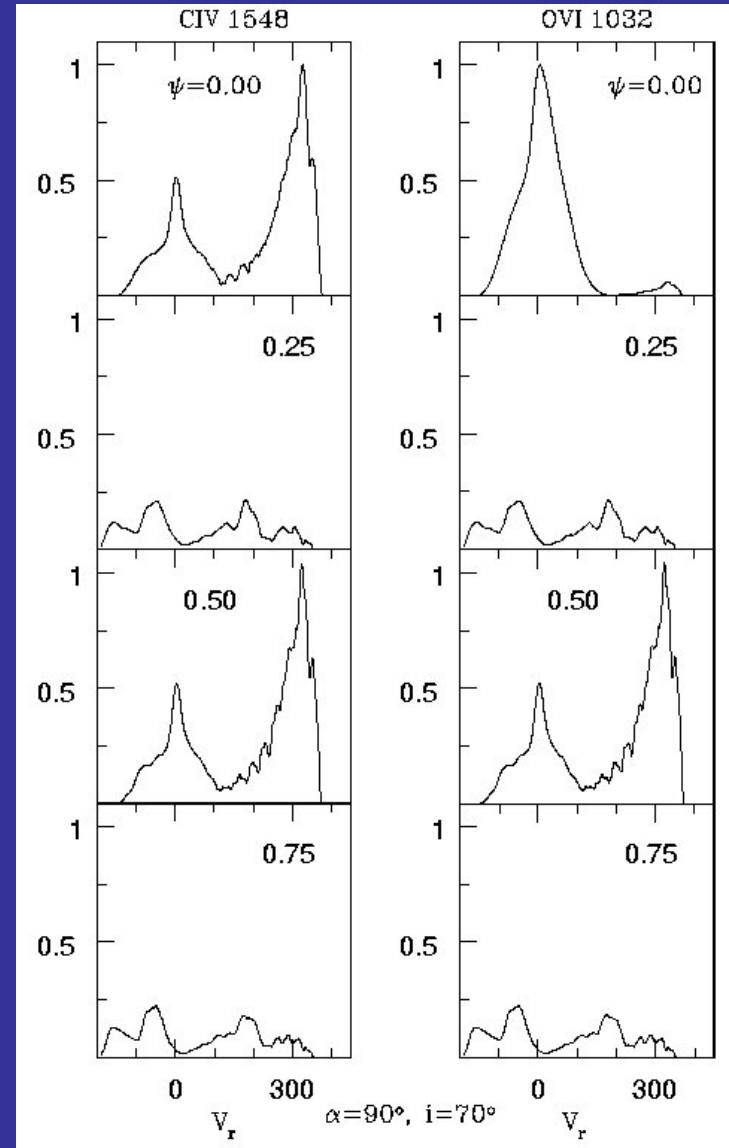
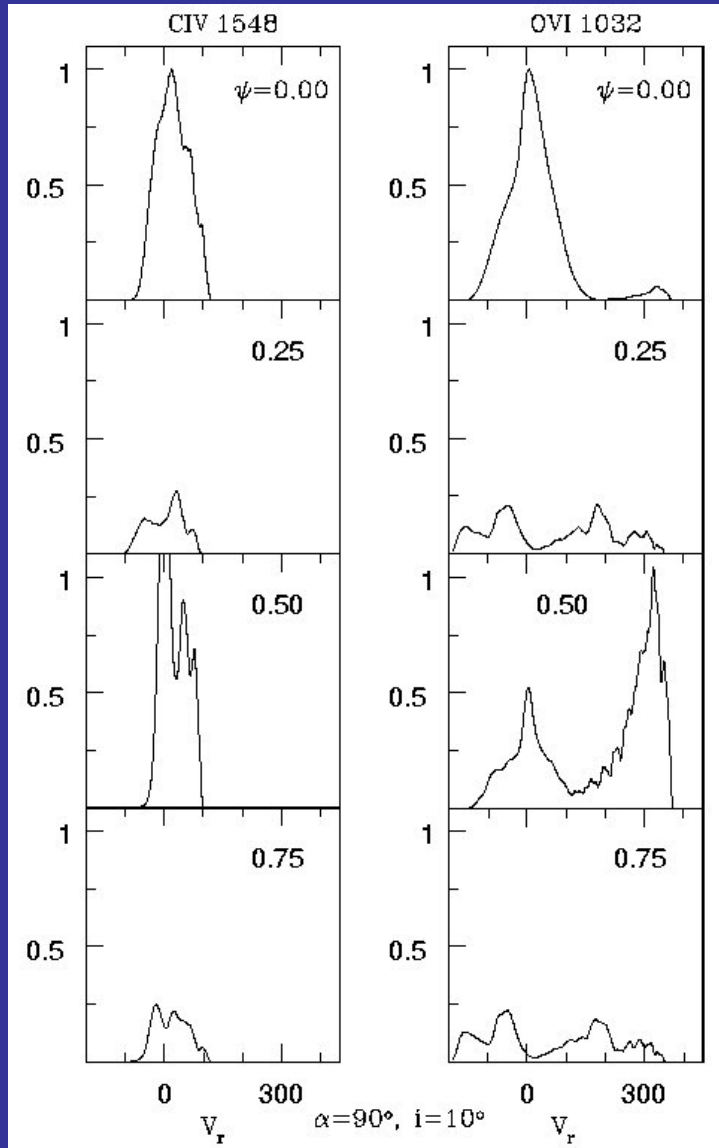
Calculated profiles of CIV 1550 and OVI 1035 doublet lines



Observed profiles of CIV 1550 and OVI 1035 doublet lines in CTTs spectra

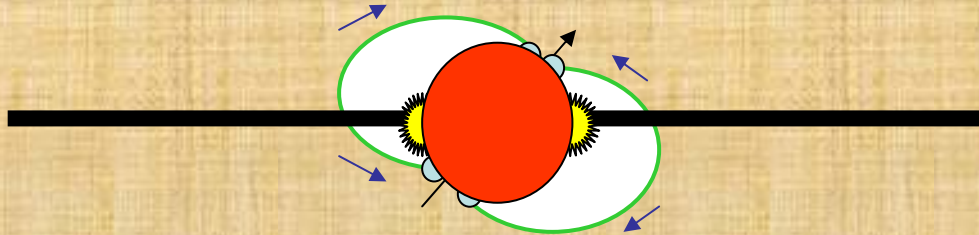


Calculated profiles of CIV 1550 and OVI 1035 doublet lines

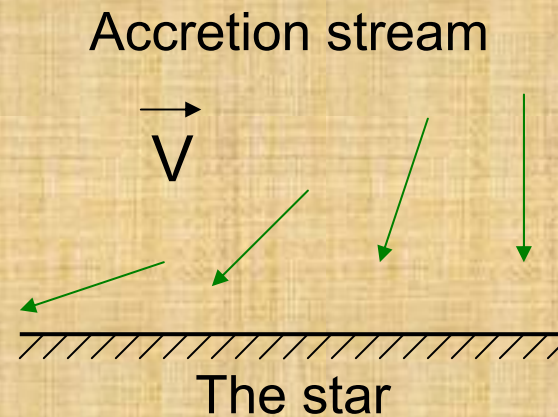
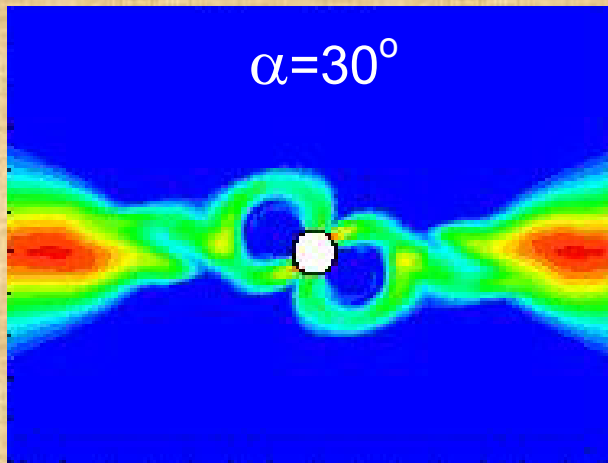


Kinematic schemes of accretion onto CTTsSs (*Kravtsova & Lamzin, 2003; Romanova et al., 2007*)

- Predominant accretion through boundary layer = magnetospheric accretion with quadrupol field

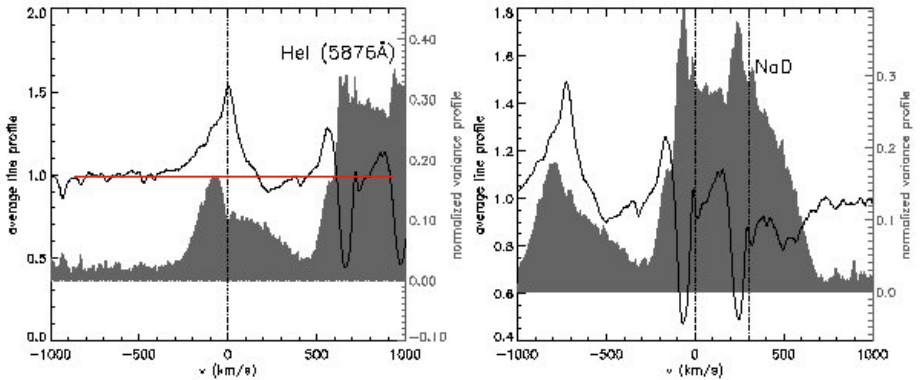
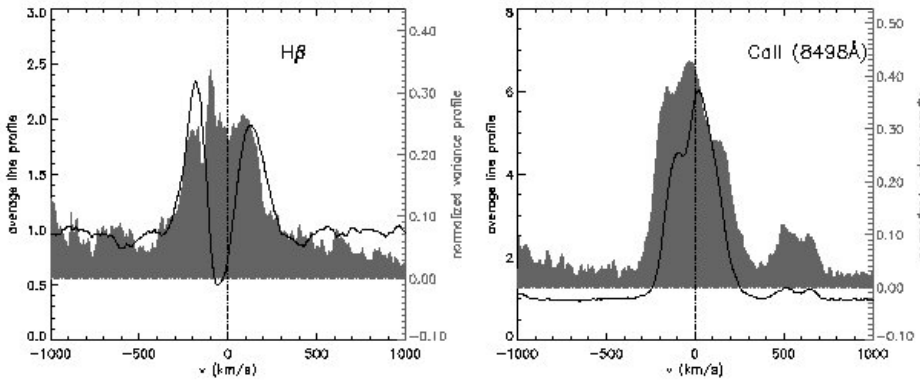
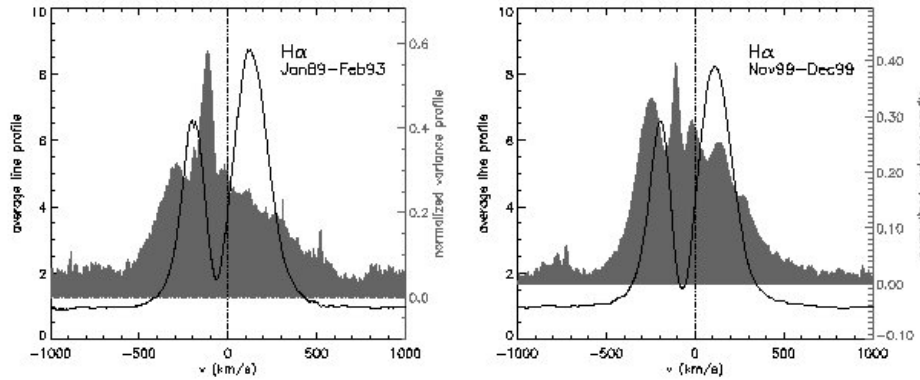


- Magnetospheric accretion with dipole-like field, but $V_t \neq 0$



Variability of lines profiles in RW Aur spectrum

(Alencar et al., 2005, A&A 440, 595)



Do broad and narrow components really exist ?

Where atomic and singly ionized atom's lines originate ?

Conclusion

Velocity field of accreted matter

(= magnetic field lines geometry)

near stellar surface of CTTSs is still poorly known.