THE STOCHASTICAL APPROACH TO THE MODELLING OF THE LINE PROFILES IN T TAURI STELLAR WINDS.

V.P.GRININ, A.S.MITSKEVICH
Crimean Astrophysical Observatory.
P.O.Nauchny,Crimea, 334413
U.S.S.R.

ABSTRACT. Line profiles calculations were carried out for spherically-symmetrical stellar wind models with discrete structure. It is shown the possibility to explain two-component emission profiles typical for T Tauri-type stars in the framework of such stochastical approach.

1.INTRODUCTION.

Intensive outflow of the matter is one of the most important property of T Tauri - type stars (TTS). There is a set of theoretical models in which this phenomenon is considered from different positions. But any of them can explain the emission line profiles which are observing in the spectra of TTS: two-component emission with a blue-shifted absorption. This defect, as we believe, is providing by the using of continuum medium assumption.

Here we present a new approach to the modelling of the emission line profiles in the framework of discret stellar wind with stochastical approach.

2.CALCULATIONS.

The calculations are organized by the following way:

1. Our initial models (the radial-symmetric continuum outflow with a giving velocity field and $\dot{M}$) assumed to be isothermal.
2. Non-LTE multilevel problems for H I, Ca I-III, Mg I-III and calculation of the source functions for the main emission lines observed in the spectra of TTS (Hα, K CaII, k MgII and some others) were carried out with the using of Sobolev escape probability method.
3. The discretization of the envelope with the help of random number code was final (and main) step. This step simulate the erruptive nature of the stellar wind, consisting from the large number (up to 10^4) of blobs.

Such models are spherically-symmetric, but not selfconsistent fully because of the using of the source functions from continuum wind models.

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3.RESULTS.

Examples of the main emission line profiles (Hα, Hβ, K CaII and k Mg II) calculated for isothermal wind are presented on Fig. 1-4. They are obtained for the following model parameters: electron temperature T_e = 7500 K , temperature of the star T_e = 5000 K (stellar radiation was approximated by Plank function), stellar radius $R_* = 3*R_\odot$.

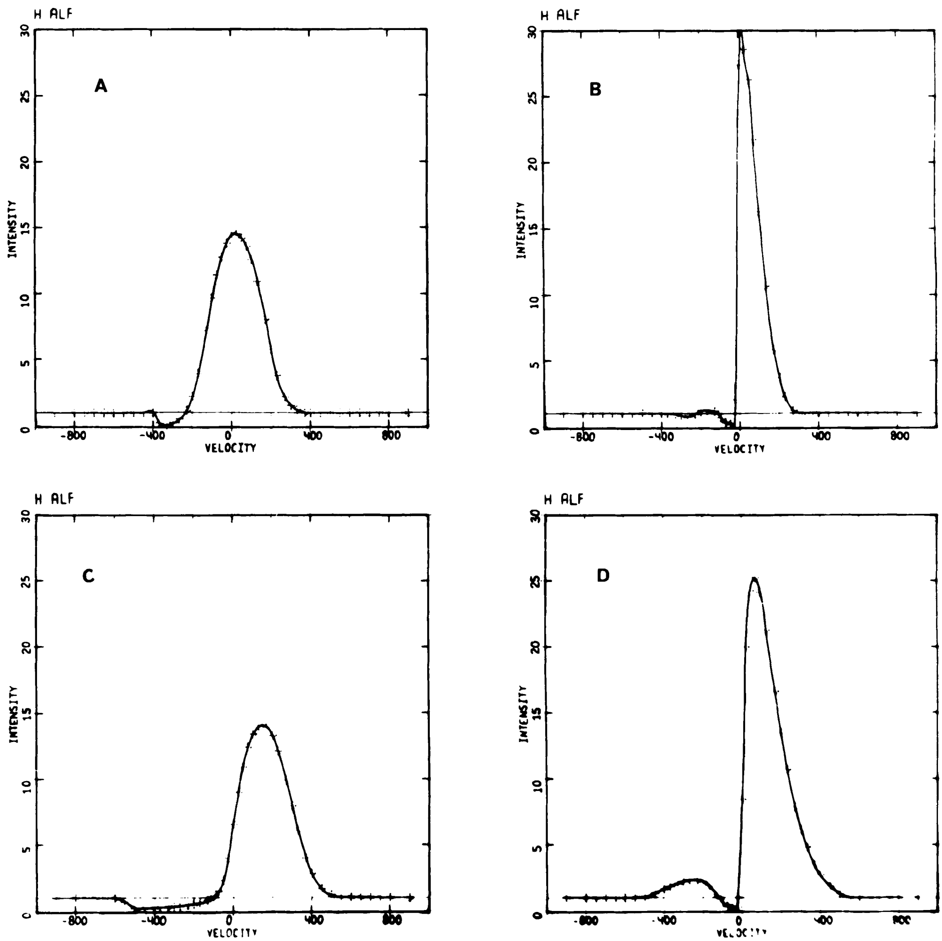

Figure 1. Theoretical profiles of Hα -line for the case of continuous outflow ($\dot{M}=3*10^{-7}$ $M_\odot$/year) with acceleration (a,c) and deceleration (b,d), with (c,d) and without (a,b) turbulent velocity.

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Two different types of kinematical models were considered :
1. outflow with acceleration (A- wind):

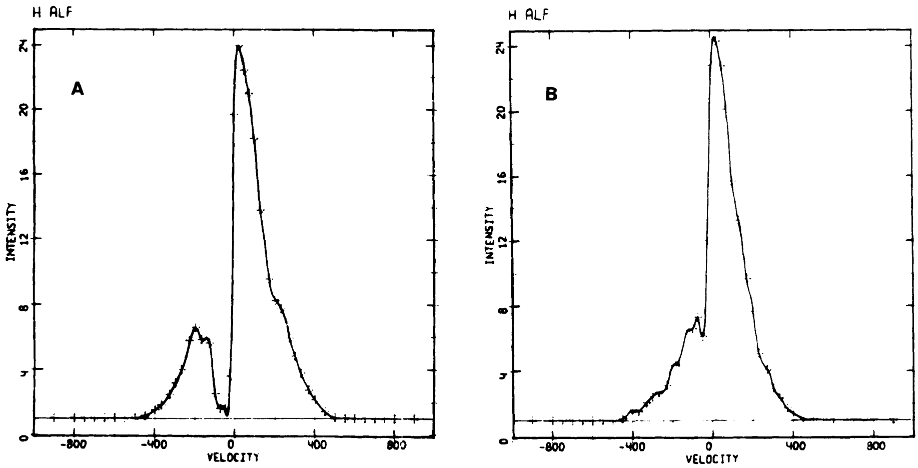
$$V(r) = V_o + V_1 (1-(r/R_*)^{-1/2}) ;$$

2. outflow with deceleration (D- wind):

$$V(r)=V_o*(r/R_*)^{-1/2} ;$$

were maximum velocity is V_m =400 km/s in both cases.

All calculations of lines profiles were provided with an accurate equation for the intensity of escaping radiation. It allowed to consider two limiting cases of the motion with and without turbulent velocities: $V_{turb}(r)= A*V(r)$ were scaling factor was A= 0. and 0.3 .



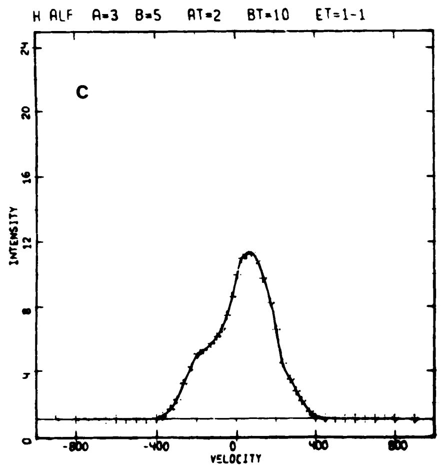


Figure 2. The theoretical Hα -profiles for the stochastical D-wind (a,b) and A-wind (c) models with a turbulent velocity for different meanings of the filling factor q:
a) q=1/12, b) q=1/30, c) q=1/12.
In all cases $\dot{M} = 3*10^{-7} M_o$ /year.

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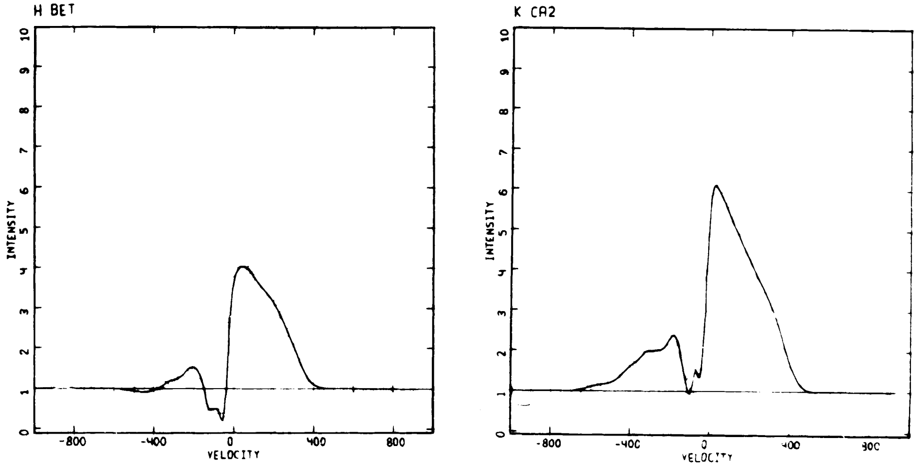

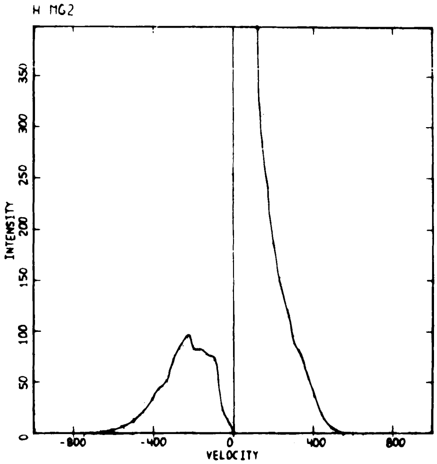

Figure 3. The theoretical Hβ, K CaII and k MgII lines profiles in the stochastical model of D-wind with turbulent velocity q=1/12, $\dot{M}=3*10^{-7}$ M_{o}/year.

4.CONCLUSION.

Two-component emission lines profiles presented above are typical for TTS. The radiative transfer theory explaines usually such type of profiles in the framework of chromospheric models or rotating gas envelopes. The models with stochastical outflows permit us to interpretate these profiles in the framework of purely radial-symmetric motion with deceleration.

The explanation is very simple: in this kinematicthe outer region of stellar wind is continuous in the optical sence because of the blending of elementary absorption lines which are produced by discret blobs. It is naturally to connect the physical mechanism which could drive such stellar wind from TTS with their intensive flare activity.

More discussions about calculations will be published.

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