

# ON THE BALMER PROGRESSION PHENOMENA IN Be STARS

Ryuko Hirata

DEPEG, Observatoire de Paris, Meudon,

on leave from Department of Astronomy, University of Kyoto

Typical Balmer progression phenomena in Be stars are characterized by  $dv/dn < 0$  when  $v < 0$  (negative progression) and  $dv/dn > 0$  when  $v > 0$  (positive progression), where  $v_n$  is the observed radial velocity of the  $H_n$  line. We examine the conditions, under which the observed progression occurs. The shell absorption-line profile,  $R_n(v)$ , expressed in depth, is written as

$$R_n(v) = \sigma(v) \{1 - \exp[-\tau_n(v)]\},$$

where  $\sigma(v)$  is the fractional area of the stellar disk which is screened by the velocity zone of  $v$ , and  $\tau_n(v)$  is the mean optical thickness of the velocity zone for the  $H_n$  line (Kogure et al. 1978). We define  $v_{\sigma}$  and  $v_{\tau}$  as the line-of-sight velocities at which  $\sigma(v)$  and  $\tau_n(v)$  take respective maximum. Then, the negative and positive progressions could occur for  $v < v_{\sigma} < 0$ , and  $v > v_{\tau} > 0$ , respectively. We examine various velocity fields and geometries from this point of view. Numerical simulations have been also performed in order to check the validity of our simple consideration in the three-dimensional envelope, and also to examine the emission effect.

We obtained the following conclusions:

- 1) The cyclic (positive ↔ negative) progression phenomenon observed in 48 Lib and  $\zeta$  Tau can be most easily explained by the precession of the elongated disk. Such a model can also account the characteristics of the observed variation of shell-line profiles, in addition to the V/R variation.
- 2) In the case of axially symmetric envelope, the observed negative (positive) progression could occur only in the decelerating outflow (accelerating inflow), only if the line optical thickness decreases outwards. The latter condition requires special temperature structure. It is impossible to account for the negative progression observed in Pleione's shell episode by Limber's (1969) model.

The full paper will be published elsewhere.

## REFERENCES

- Kogure, T., Hirata, R., and Asada Y.: 1978, *Publ. Astron. Soc. Japan*, 30, pp. 385-407.  
Limber, D.N.: 1969, *Astrophys. J.* 157, pp. 785-797.