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# ANOMALOUS V/R VARIATION IN EW Lac

Hadrava et al.(1978), Harmanec et al.(1979), and Hirata and Kogure (1979) reported that EW Lac (HD 217050, B2 IIIpe, shell) has shown a strong change in its spectrum and colors in 1978, after a long stable shell-star phase. Poeckert (1980) has made a detailed study on the radial velocity and line strength changes in 1978 - 1979.

We have examined the spectral variation of EW Lac for the period of 1973 - 1980, on about 60 spectrograms which were obtained at the Okayama Astrophysical Observatory. Our examination has been made mainly on the V/R relation of violet (V) and red (R) emission components and the asymmetric feature of spectral line profiles. As the result we have found an anomalous V/R variation which has begun in 1975 and is still lasting in 1980.

The results of our inspection are summarized in Table I, where V/R relation is shown by an equality or an inequality between V and R components. When no emission is seen, the letter N is used instead of the respective V and R. The letters C and Z in the column of Sp denote the high- and low-dispersion spectrograms, respectively, obtained with the following spectrograph: C = coudé spectrograph attached to the 188-cm reflector, the dispersion being approximately 10 A/mm for Hβ are bluer spectral region, and 20 A/mm for Hα. Z = prism spectrograph attached to the 91-cm reflector, the dispersion is 72 A/mm at Hγ.

The asymmetric feature of the shell absorption profiles in higher members of the Balmer series (H10 ∿ H20) is given in Table I with the designation of: sym = symmetric, asym = asymmetric, R-fade = the wing in the red side is

fading-out, and V-fade = the wing in the violet side is fading-out. In the last column is given the principal quantum number $n_\ell$ of the upper level of the last visible Balmer lines. The value of $n_\ell$ may be thought as an indicator of the development of the shell-line forming envelope (Kogure et al, 1978).

Table I. V/R variation of EW Lac

| Epoch | Sp | V/R relation | | | | | Profiles of higher members | $n_1$ |
|---|---|---|---|---|---|---|---|---|
| | | Hα | Hβ | Hγ | Hδ | H8 | | |
| 1973 V | C | - | - | - | V∿R | N=N | sym. | 33 |
| XI | C | V=R | V=R | V=R | V∿R | N=N | sym. | 36 |
| 1974 VIII | C | V=R | V=R | V=R | V∿R | N=N | sym. | 36 |
| X | C | V=R | V∿R | V∿R | V∿R | N=N | sym. | 40 |
| 1975 XI | C | V=R | V=R | V∿R | V≳R | V≳N | slightly asym. (R-fade) | 34 |
| XII | Z | - | V∿R | V≳R | V≳R | - | (sym.) | - |
| 1976 VIII | Z | - | V∿R | V≳R | V≳R | - | sym. | - |
| XI | C | - | V≲R | V∿R | - | - | - | - |
| 1977 VIII | C | - | - | - | V>N | V>N | asym. (R-fade) | 36 |
| X | C | V≲R | - | - | V>N | V>N | asym. (R-fade) | 36 |
| 1978 XI | C | V∿R | V>R | V>R | V>N | V>N | asym. (R-fade) | 37 |
| 1979 V | C | - | - | - | V>N | N<R | nearly sym. | 31 |
| VIII | C | V>R | - | V>R | V∿R | N<R | asym. (V-fade) | 32 |
| XI | C | V>R | V>R | V∿R | V<R | N<R | asym. (V-fade) | 35 |
| 1980 VII | C | - | - | V<R | V<R | N<R | asym. (V-fade) | - |
| IX | Z | - | V≳R | V<R | N<R | N<R | asym. (V-fade) | - |
| XI | C, Z | V>R | V<R | V<R | N<R | N<R | asym. (V-fade) | 36 |
| XII | Z | - | V<R | V<R | N<R | N<R | asym. (V-fade) | - |

From Table I we readily see that the asymmetric profiles can be traced back as early as 1975 in Hδ and H8, and, since then EW Lac seems to have

entered a new phase of anomalous V/R variation, which is characterized by a kind of propagation of V/R relation from higher to lower members of the Balmer series.

The characteristic feature of this V/R variation may be stated as follows.
(1) Successive appearance of two opposite types of V > R and V < R propagation. The first V > R propagation has started in 1975 from H8 and reached Hα about 4 years later. The duration of the same V > R relation for each Blamer line is 2 ∿ 4 years. The second V < R propagation has started in 1979 from H8 and reached Hβ in 1980. The time scale may be the same as before.
(2) Association with the asymmetric profiles of higher members of the Balmer series. The first V > R propagation is related with the F-fade asymmetry, whereas the second V < R propagation is with the V-fade asymmetry.
(3) Relationship with the value of $n_\ell$. The value of $n_\ell$ takes its minimum at the onset of V/R propagation ($n_\ell$ = 34 in 1975 and 31 in 1979) and increases gradually up to its maximum at the end of the same phase of V/R propagation ($n_\ell$ = 37 in 1978).

Complicated behavior of this anomalous V/R variation offers an interesting theoretical problem. If we adopt the eccentric rotating ring model suggested by Huang (1973, 1975), the successive V > R and V < R propagation may be explained qualitatively by adopting multiple eccentric rings whose major axes are oriented to progressively rotated directions. Quantitatively, however, this simple model involves many difficulties. Particularly, an important point to be explained is why EW Lac has entered a new phase of anomalous V/R variation after a long stable period. Further investigations observational as well as theoretical are much desired.

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References:

Hadrava, P., Harmanec, P., Koubský, P., Krpata, J., Ždárský, F. 1978, IAU Circular No. 3317.

Harmanec, P., Horn, J., Koubský, P., Ždárský, F., Křiž, S. and Pavlovski, K. 1979, IBVS No. 1555.

Hirata, R. and Kogure, T. 1979, IBVS No. 1575.

Huang, Su-Shu 1973, Ap. J., 183, 541.

Huang, Su-Shu 1975, Sky and Tel., 49, 359.

Kogure, T., Hirata, R., and Asada, Y. 1978, Publ. Astron. Soc. Japan, 30, 385.

Poeckert, R. 1980, Publ. Dom. Ap. Obs., Victoria, XV, 357.