Hα- and HeI6678-Monitoring of P Cyg

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Summary

The dormant LBV-star P Cygni, the most popular representative of the class of the so-called **L**uminous **B**lue **V**ariable shows various interesting spectral changes. These are particularly the variations of the Hα-emission and the line strengths of the HeI6678-emission/absorption. In both cases a long-term monitoring by amateurs permits offer valuable data the professional research.

I would like to present results from the observational period September 1994 to May 2005. During this period the equivalent width varied from 60 to 100 Å. The data over nearly 10 years document the slow passage through a minimum in equivalent width. Superimposed we see a quasi-periodic microvariation on time scales of weeks to months. The overview in fig.1, results from our group are the blue, red and green points. These results encourage to continue the monitoring in the same way for some more years in order to search for Hα-variability in a much larger and continuous data base.

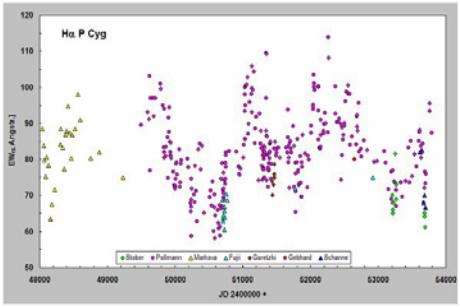

Fig.1: Time behavior of the Hα–emission

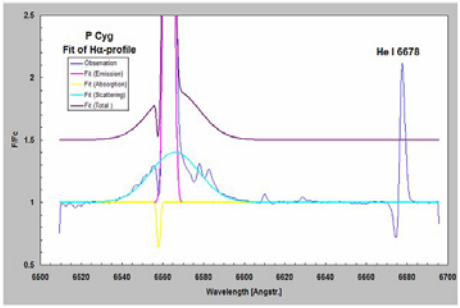

Fig. 2: The individual components of the Hα-emission in the spectrum of P Cygni

The individual components of the Ha-emission in the P Cygni spectrum (fig. 2) originate in different processes:

1. Shell-emission

the strong emission, which is produced by the expanding shell

2. Scattering

Superposed onto the emission one can find a very broad but weak emission, so called “emission wings”. This radiation originates from photons which are being scattered by the shell´s fast free electrons consequently resulting in rather high red and blue shifts. These free electrons move considerably faster than the shell´s Hydrogen atoms since their masses are only a very small fraction of the latter’s masses

3. Blue shifted absorption component

The shell´s material in front of the star contributes to an absorption line in the stellar spectrum. All this material is moving towards the observer; therefore, the absorption line is shifted to shorter wavelength than the rest wavelength. Outside the afore mentioned direction the material also has velocity components toward the observer, but this material is not in front of the star. This material only emits light. It therefore contributes to a slightly blue shifted emission line.

The observed line profile can be modeled by simultaneous fitting with a constant function, a small gaussian function covering the emitting shell, a broad gaussian function covering the scattering phenomena and a reverse gaussian function covering the absorption. The shell emission serves as a measure for the amount of emitting gas residing in the star’s hull not being altered by absorption which itself is just an effect of projection.

Hα-profile variations may be caused by changes of the stellar winds (rate changes of mass loss). In case the star loses more mass per time unit more mate-

rial resides in the shell resulting in a stronger shell emission. Concerning Ha there is a risk that absorption will be saturated by the nearby residing huge emission simply due to small variations of the observer's spectral resolution, i.e. even big changes of mass loss rate will alter the absorption strength only a little.

Concerning the HeI6678-line this problem is of lower importance since this line reacts much more sensitive to changes of mass loss rate due to its lower optical density compared to Hα (fig.3 and fig.4).

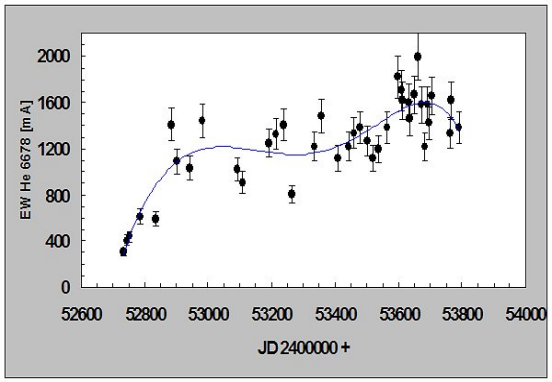

Fig. 3: EW variability of the He6678 absorption component as indicator for variations of the mass loss rate (2003/04/04 - 2005/06/13)

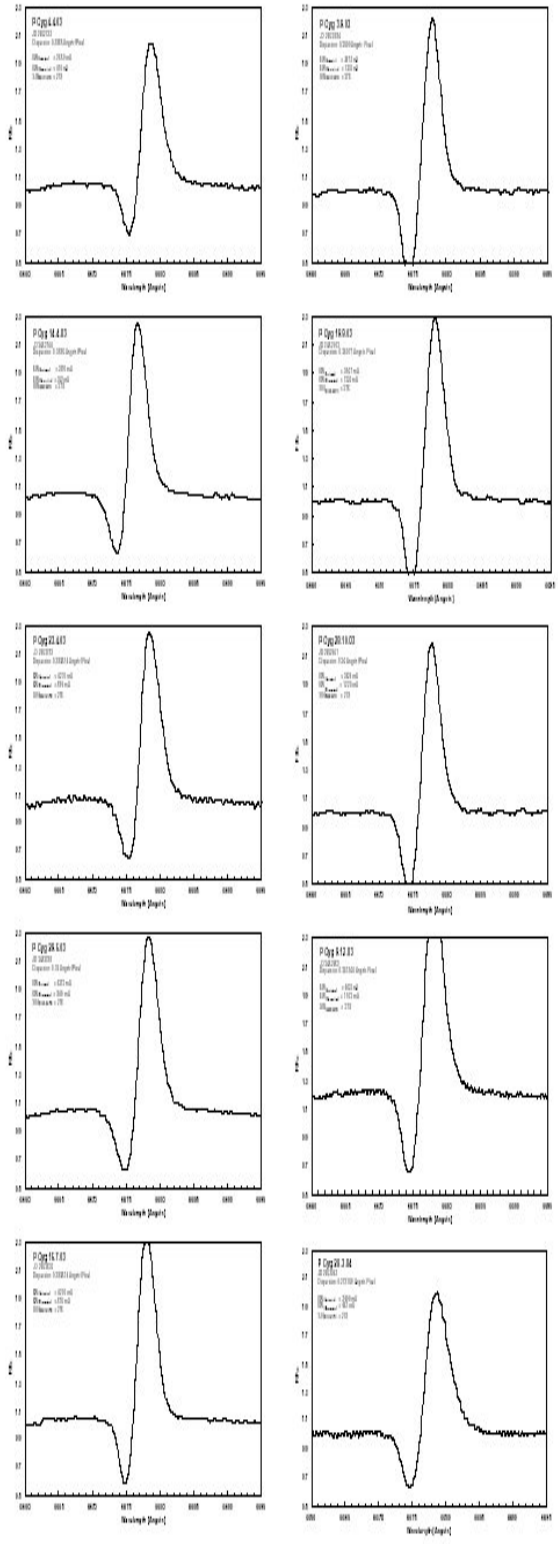

Fig. 4: An exemplary sequence of the HeI6678-line profile (2003/04/04 - 2004/03/28)