<u>Hα - and HeI6678-Monitoring of P Cyg</u>

(Hα-Monitoring published in Be Star Newsletter)

I would like to present observational results from the dormant LBV star P Cygni. A luminous blue variable star (LBV), which inclined every few hundred years to increase its brightness in enormous outbursts. The largest stars over 50 and up to 150 solar masses do not blow up themselves to red super giants, but have a short phase as luminous blue variable one. Then they are the brightest stars, which there are in the universe. This phase lasts only about 40.000 years. Afterwards they develop far to Wolf-Rayet-stars, or they explode directly in extremely strong super- or hypernova. Fig.1 shows P Cyg in its position in the Herzsprung-Russel diagram. LBV pulsate very irregularly and push large parts of their envelope outside into the space. They lose during the LBV phase up to 10 solar masses, thus have a larger mass loss than Wolf- Rayet stars.Only very few LBV are well-known, although they are to be found easy due to their luminosity millionfold larger in comparison to the sun. LBVs belong to the most rarely occuring and to the extremest class of the stars.

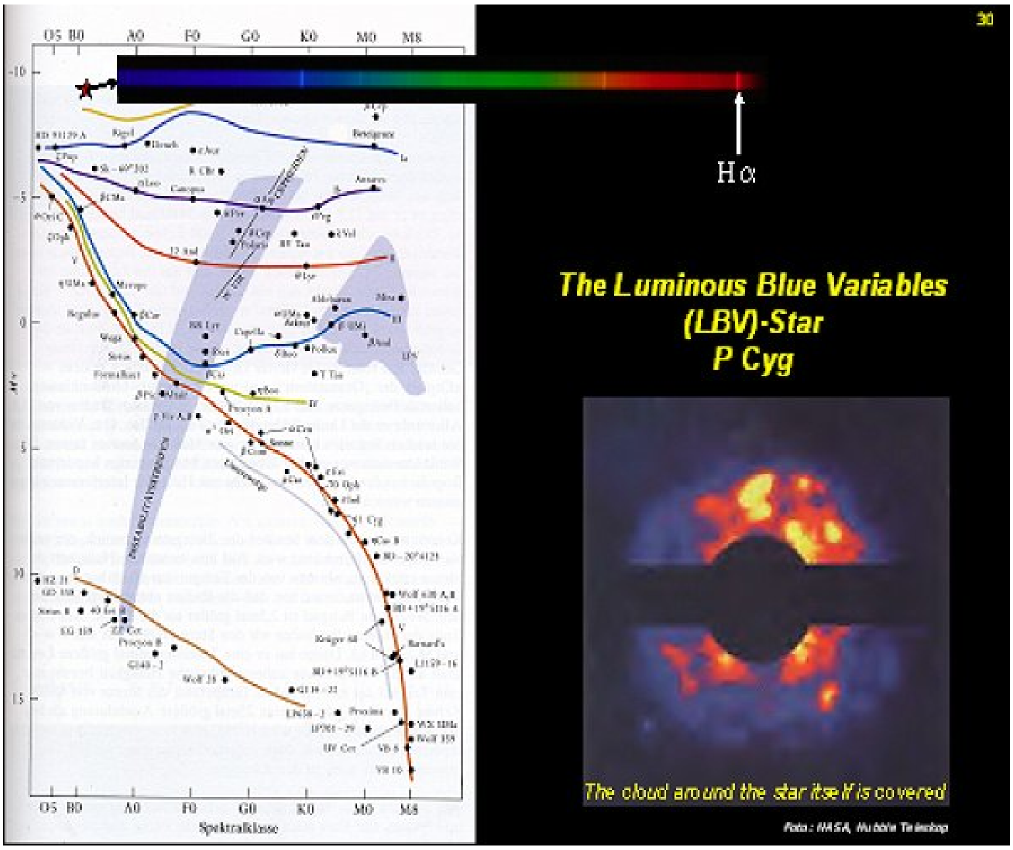

Fig.1: Position of P Cygni in Herzsprung-Russel diagram
and a HST-photo of the cloud of the star

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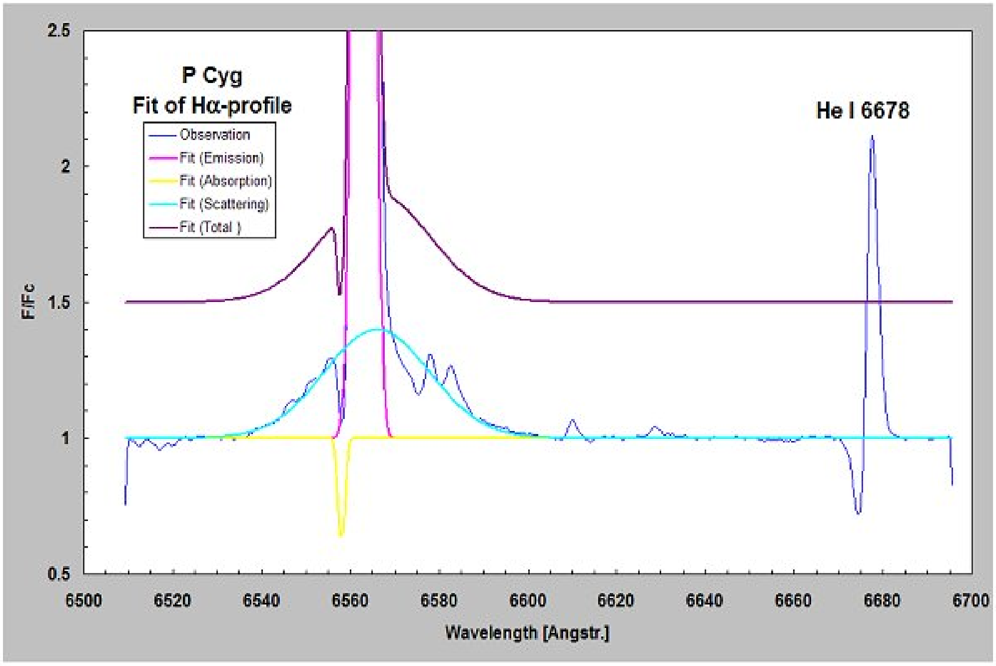

Fig. 2: The individual components of the Hα-emission in the spectrum of P Cygni.

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

1. Envelope-emission

The strong emission, which is produced by the expanding envelope

2. Scattering-emission

Being under the emission, a very broad, however weak emission (so-called emisson wings). This is produced by photons, which are scattered on quick electrons in the envelope of the star and are therefore strong shifted to blue and red.

3. Blue shifted absorption component

The absorption develops only there, where one can see the envelope of the star in projection against the star disk. Since the envelope expands in all directions, the absorption comes just from that part to us, we can see against the star disk. Therefore it is blue-shifted.

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.

The observational period in fig. 3 covered July 1988 until today, during which the equivalent width varied from 60 to 100 Å. These data over nearly 20 years comparing measurements by professional instruments and our group document the slow passage through a minimum in equivalent width (EW) with a quasiperiodic behavior. Superimposed we see also a quasiperiodic microvariation on time scales of weeks to months. 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.

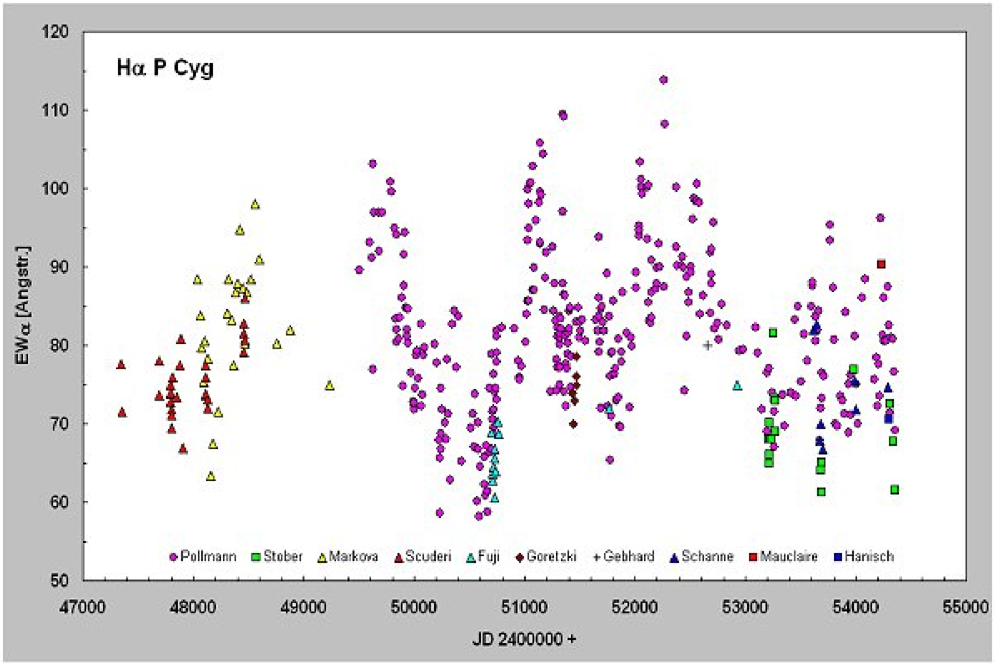

Fig.3: EW long-term behavior of the Hα emission

Variations in Hα can be attributed to changes in the mass loss rate. If the star loses more mass per time unit, then more material is in the envelope and one gets a stronger envelope emission. A suitable indicator for the determination of the mass loss rate could be the absorption component of HeI6678 (see fig.4).

With Hα the danger exists, that by small changes in the spectral resolution the absorption apart from the enormous emission becomes strongly saturated or is filled up. Even strong changes of the mass loss rate change the absorption strength only less.

With the HeI6678-Linie that problem is not quite like that engraving. It reacts many more sensitively to mass loss variations, because the optical density is not as high as in Hα. Fig. 4 shows an exemplary sequence of the HeI6678-line profile (2003/04/04 - 2004/03/28). Fig. 5 shows the EW-variability of the He6678 absorption component as indicator for variations of the mass loss rate from April/2003 until today.

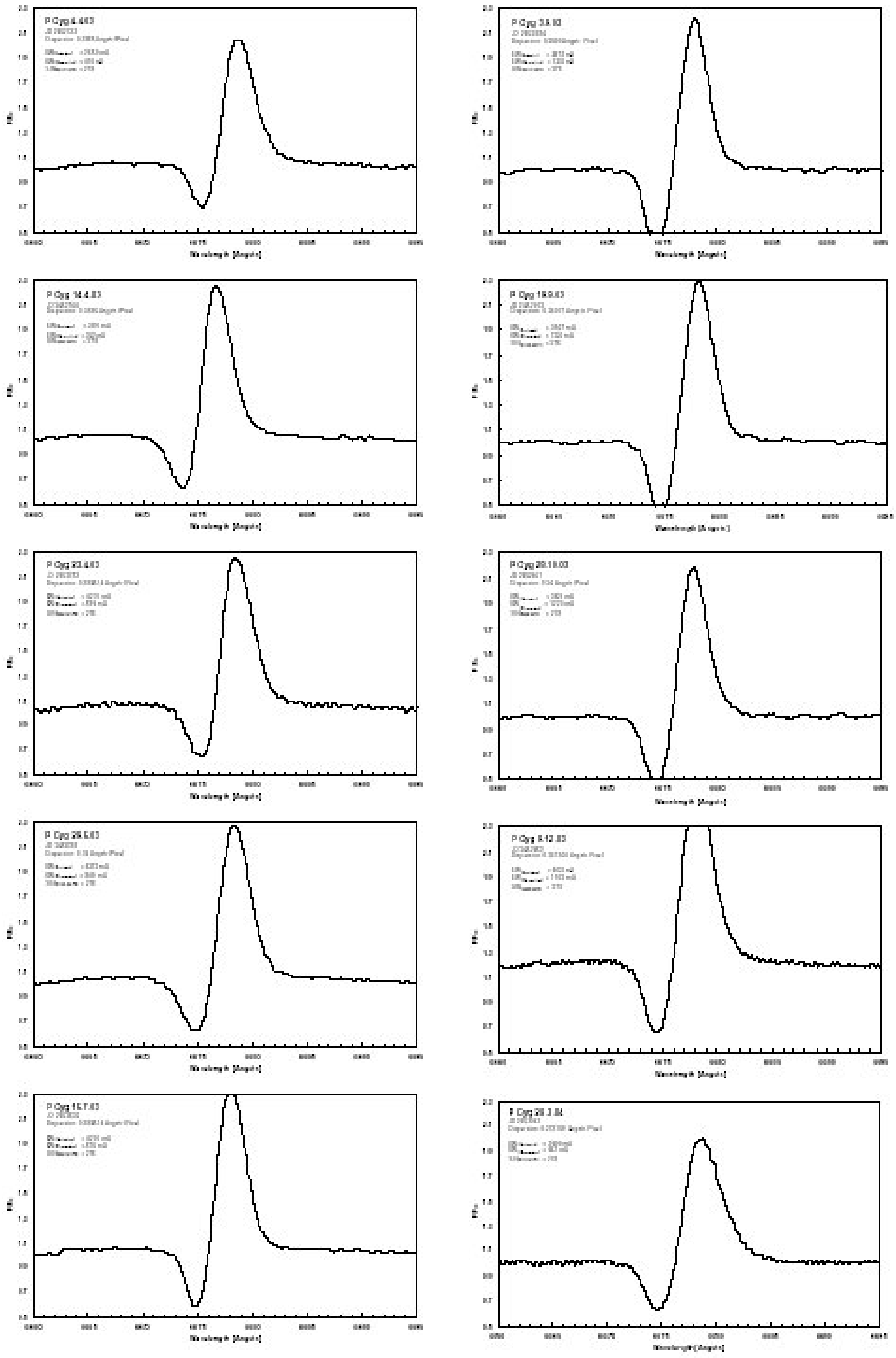

Fig. 4: An exemplary sequence of the HeI6678-line profile (2003/04/04 - 2004/03/28)

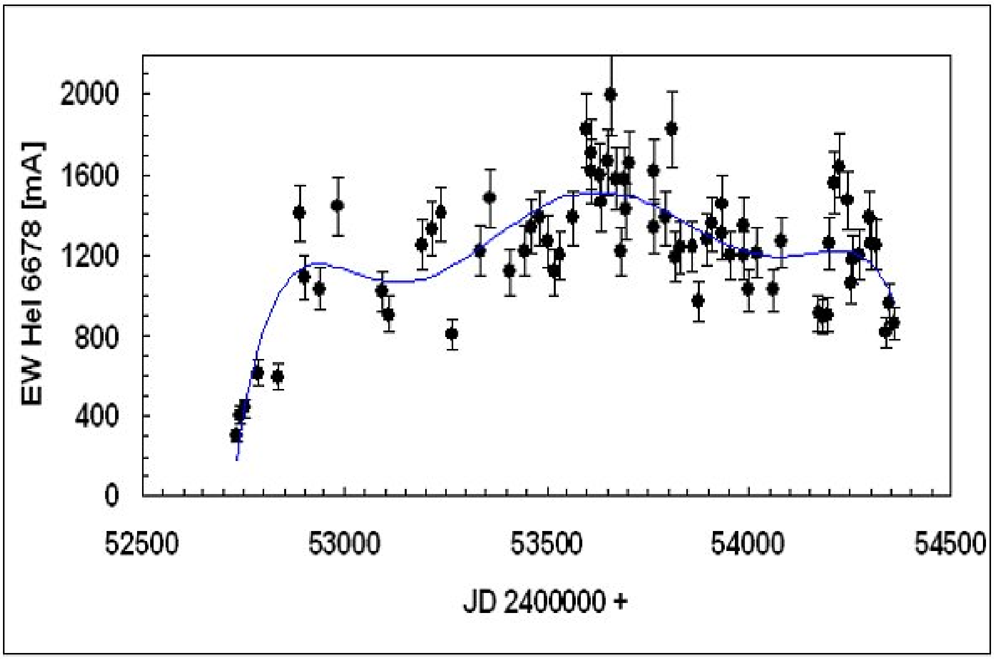

Fig. 5: EW variability of the He6678 absorption component
as indicator for variations of the mass loss rate (2003/04/04 - 2007/09/30)