Monitoring of the HeI 6678 absorption line intensity of P Cyg

(Ernst Pollmann, June 2021)

Aside from the long-term Hα intrinsic line flux campaign, (http://app.aavso.org/jaavso/article/3590/) there is also a further monitoring of the He6678 absorption component, to determine characteristics of the mass loss rate. This monitoring was started in April 2003. The presented results of the variability of the He6678 absorption line intensity as F/Fc in P Cygni´s optical spectrum, are based on more than 560 high-resolution spectra taken from April 2003 to November 2020. The approx. 100 spectra from April 2003 to June 2012 in Fig. 1 show that the absorption component is shifting towards shorter wavelengths where the line profile variations are located. This could be due to increasing optical depth as a result of increasing mass loss.

This feature probably represents a fundamental characteristic of the radiation-driven stellar wind and mass loss. Therefore it is of interest to study the variability in order to obtain useful information of its time behaviour. Fig. 2 shows the time behaviour of both the intensity of the emission maximum, and the max. absorption depth. Clear variations of the absorption intensity are observed. The plot of Fig. 3 shows on more than 560 spectra, that both parameters are not correlated, in opposite to the lower data set of approx. 100 spectra presented in JAAVSO Volume 41, 2013. Even if the emission comes by recombination, one would expect that a higher density (= higher mass loss) would produce both more absorption and more emission. Fig. 3 could therefore be an expression of (not implausible) temperature variations in the stellar wind, whereby the absorption could increase also without change of mass loss, thereby without the emission increasing.

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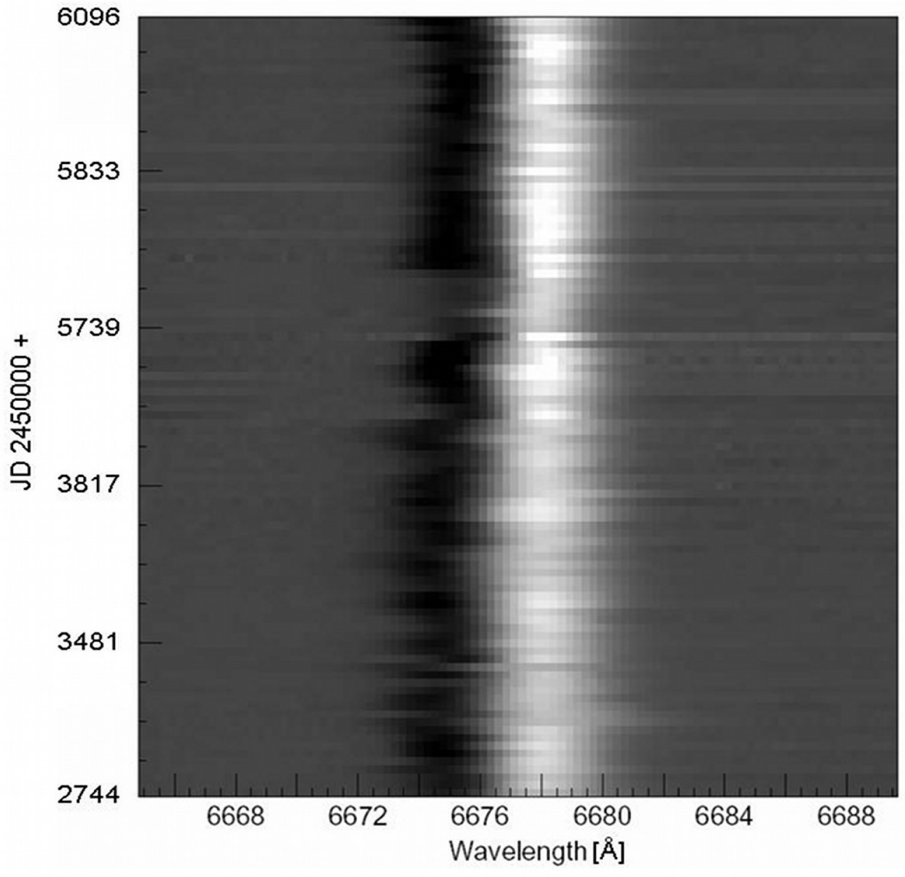

Fig. 1: The moving absorption maximum (around 6675 Å) of the He 6678 line profile with time for P Cyg. 100 Spectra sorted by Julian Date.

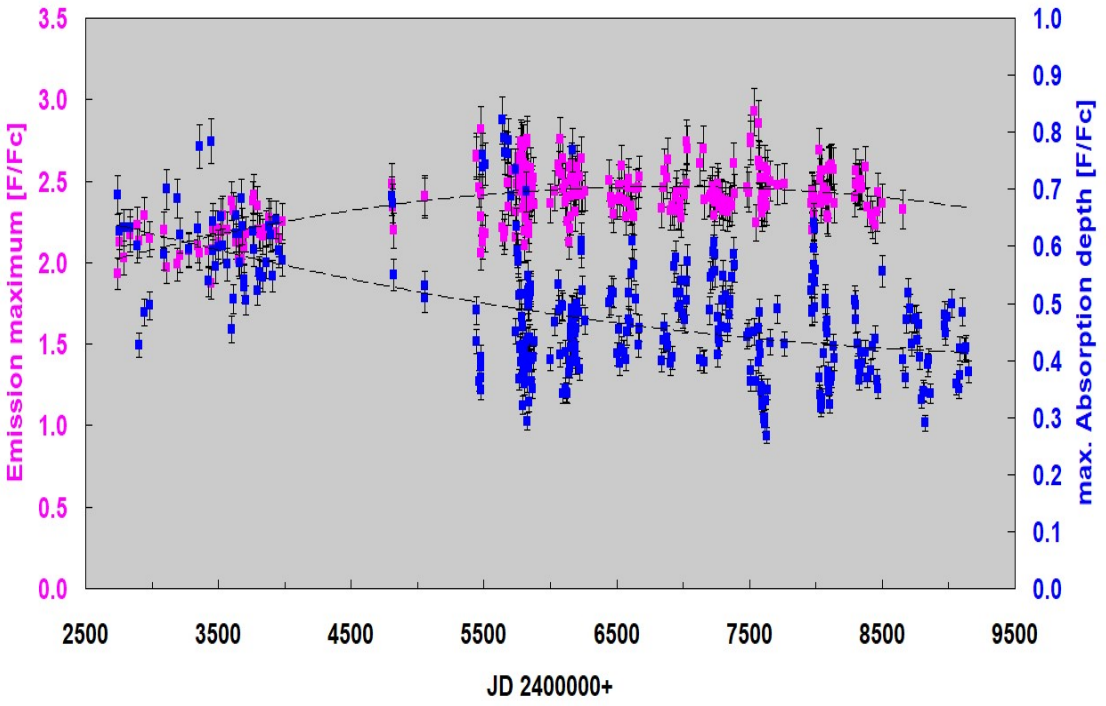

Fig. 2: Time behaviour of the intensity of the emission maximum and the max. absorption depth. Clear variations of the absorption intensity are observed.

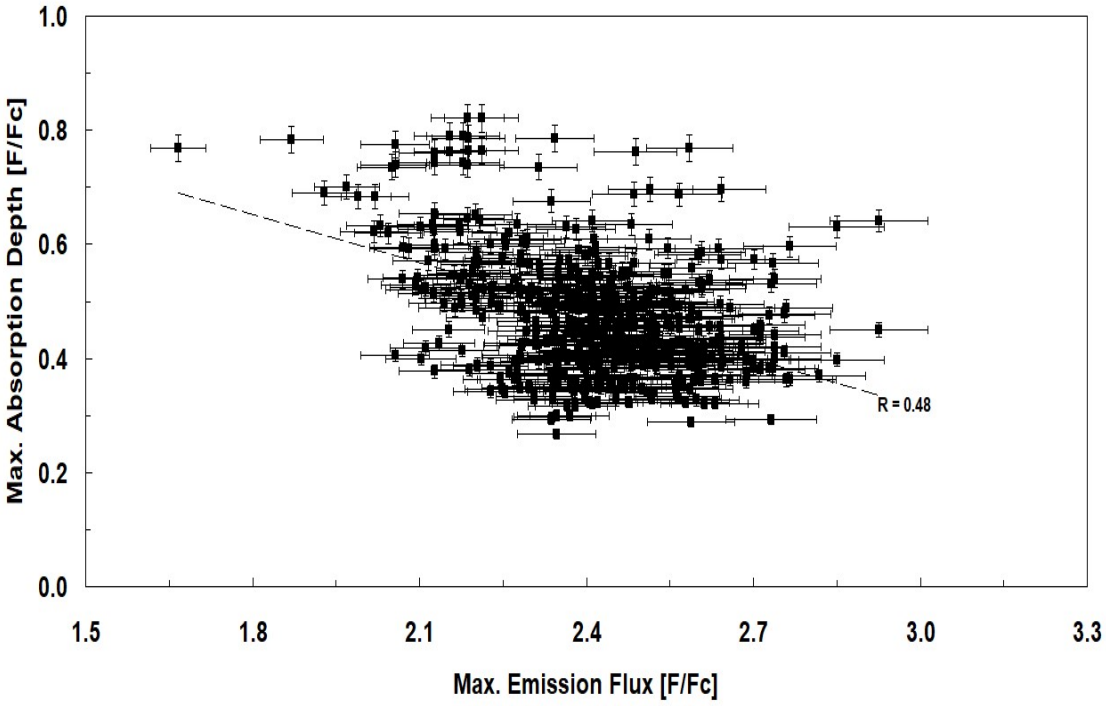

Fig. 3: Variability of the absorption depth versus emission strength of the HeI 6678 line (April 2003 to November 2012) for P Cyg. Both parameters are not correlated.

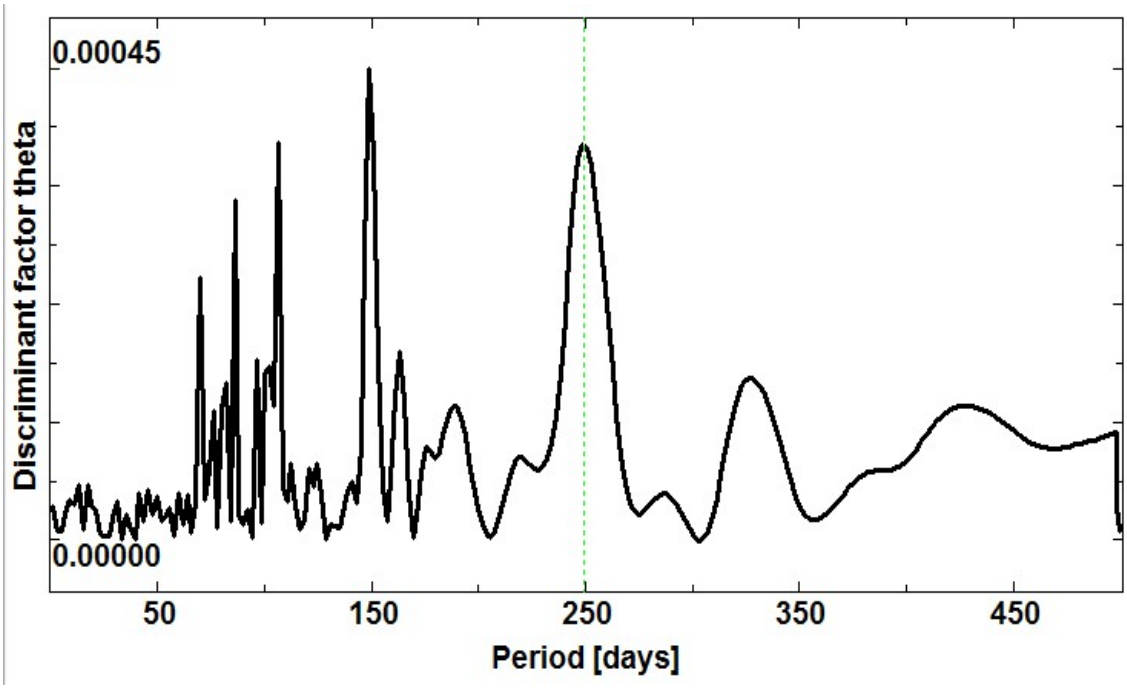

Fig. 4: Scargle Period Analysis of the data
JD 2452744 to JD 2459153 in Fig. 2; Period 249 d

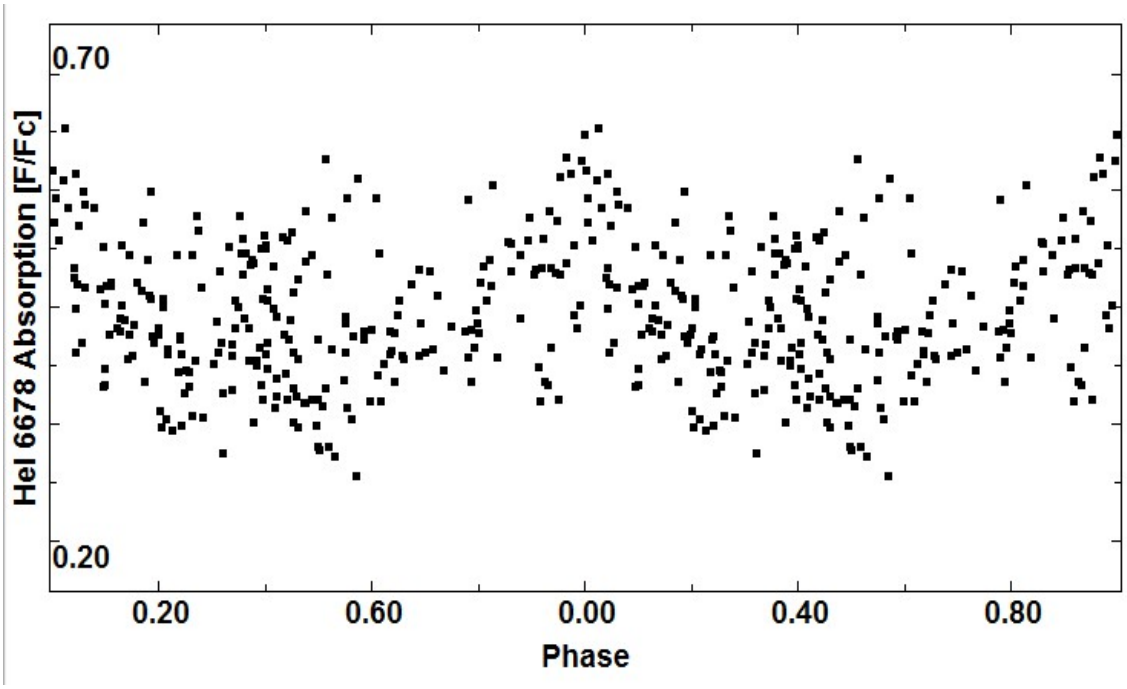

Fig. 5: Phase plot of the 249 d Period in Fig. 4

For the time period JD 2452744 (April 2003) to JD 2459153 (November 2020), a cyclic variation of the blue shifted absorption of this line is clearly observable (Fig. 2). A new period analysis of this time section led to a period of 249 days (Fig. 4). Fig. 5 shows the phase plot of this period. Whether this period continues to exist in the future, will be the objective of monitoring among others.

The following observers took part at the project:
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