

## Radial Velocity of the Absorption Core of the HeI 6678 Emission in $\gamma$ Cas

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by Ernst Pollmann, 2018-07-03

With 110  $\gamma$  Cas, HeI 6678 BeSS database spectra<sup>1</sup>, along with data of Harmanec et al. (A&A, 364, 2000, hereinafter referred as HA), it was possible to draw a total overview of the radial velocity (RV) time behaviour of the absorption core of the HeI 6678 emission in  $\gamma$  Cas from 1993 until now (Fig. 1). The time base of 25 years in that long-term overview with the BeSS spectra starting from September 2000, demonstrates the continuation of the RV process from where the HA measurements ended.

The enormous RV change of the absorption core of the HeI 6678 emission of  $\gamma$  Cas in the HA investigation (open circles in Fig. 1) leads inevitably to the question about its root cause. It is interesting, therefore, to compare the total HeI 6678 RV with the evolution of the  $\gamma$  Cas H $\alpha$  equivalent width (EW) within the same monitoring period (Fig. 2).

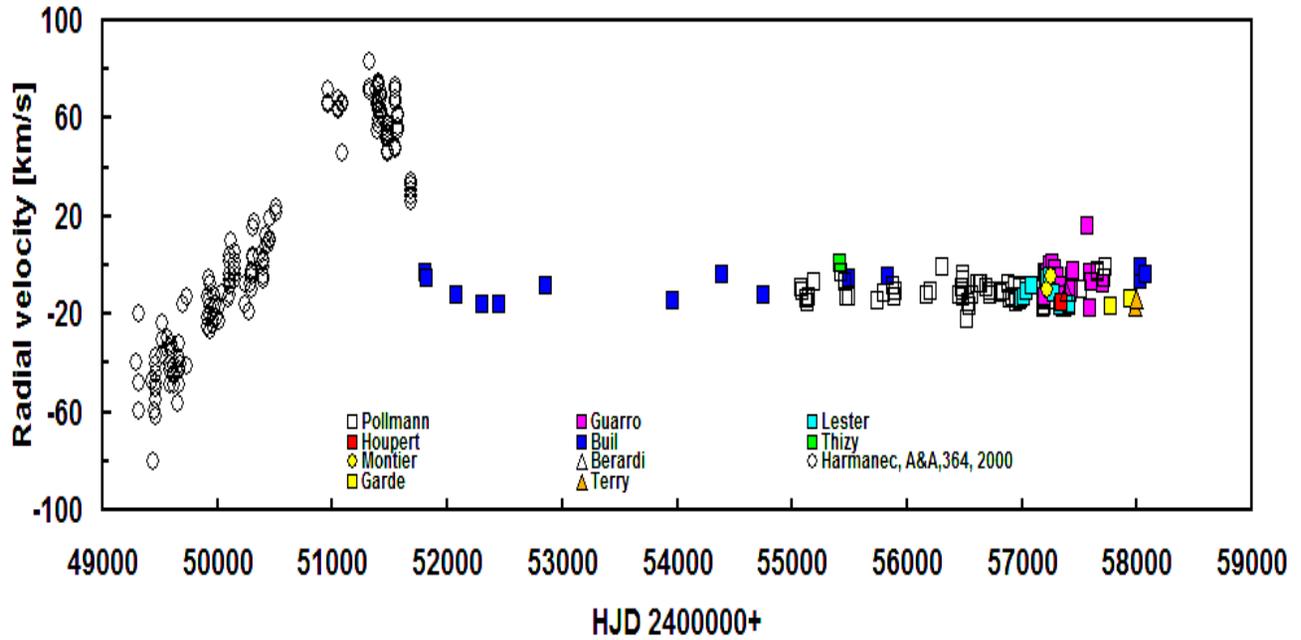
Along with the drastic change of the RV in the HA measurements, there is within the same time period a simultaneous decrease of the H $\alpha$  EW from 45 Å to approx 25 Å (~ 45 %). The H $\alpha$  EW can be seen as an indicator of the total disk mass of the primary star, which rotates, together with the inner Helium ring, counterclockwise around the star.

The H $\alpha$  EW decrease of approx. 45% shall be understood as a mass loss of the disk to about half of its original mass. The  $\gamma$  Cas binary system consists of two masses: M1 for the companion and M2 for the primary plus its mass of the disk. According to Kepler's third law ( $M1 * a1 = M2 * a2$ ) the mass loss of the disk would mean that also the distance  $a2$  of the primary plus its disk will change relative to the common center of gravity of the system.

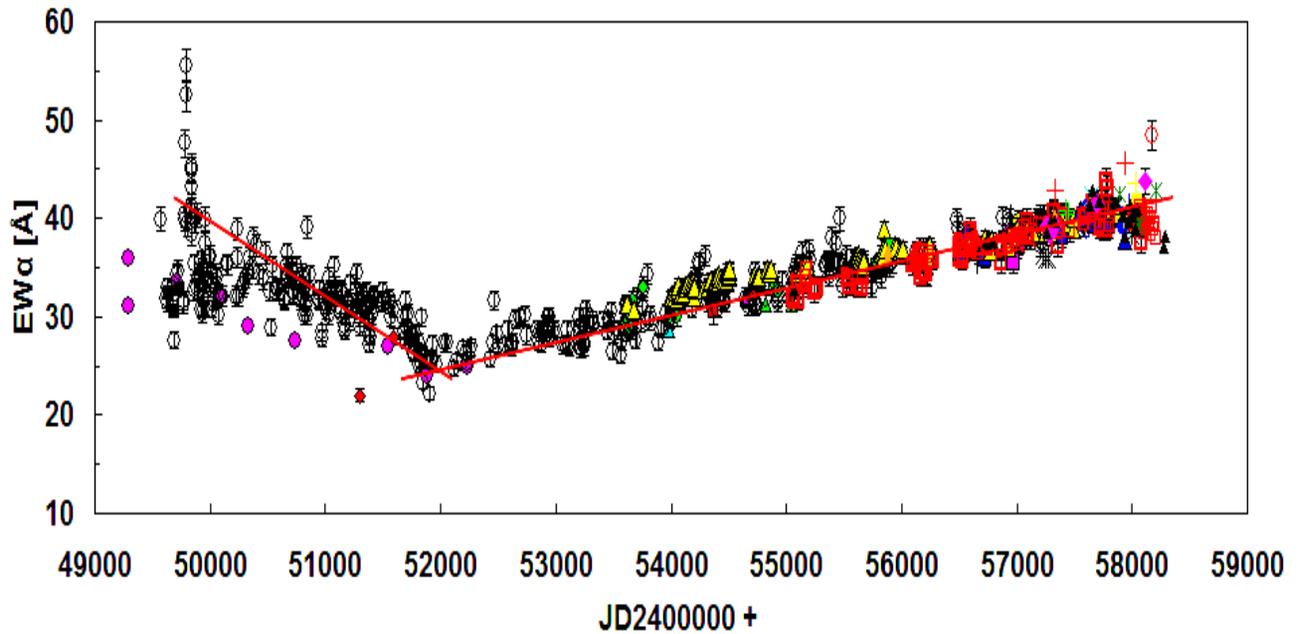
This again will explain well the change of radial velocity up to the HA maximum at approx. JD 2451500 in Fig.1. Starting at approx. JD 2451800 (see both Fig.) another interrelation will occur: Fig. 2 demonstrates a constant increase of EW. This would correspond to an increase of mass of the disk fed by mass of the primary.

But the total mass M2 (= primary star plus disk) nevertheless remains almost constant, due to the fact that the disk becomes fed by the primary. Consequently no increase of RV will occur. This is consistent with both observations of the radial velocity of the HeI 6678 absorption core and the equivalent width of H $\alpha$ .

- 1) BeSS spectra of the following observers are used:  
J. N. Terry, J. Guarro, F. Hupert, O. Garde, O. Thizy, P. Berardi, Ch. Buil, T. Lester,  
E. Pollmann



**Figure 1: RV Monitoring of the absorption core of the Hel 6678 emission since 1993 until now**



**Figure 2: Monitoring of the H $\alpha$  equivalent width since August 1994 until now (magenta dots: Miroshnichenko; open circles: Pollmann; others: ARAS group)**