# Campaign Monitoring Radial Velocity of HeI 6678 of γ Cas

(by Ernst Pollmann & Joan Guarro)

The ARAS radial velocity (RV) monitoring (Fig. 2) of the Hα emission profile (Fig. 1) of γ Cas has revealed irregularities of the RV curve (see Fig. 3 & 4), particularly within the period JD 2457150 to 2457370, probably caused by restructuring and/or turbulence in the disk (Smith & Miroshnichenko, BeSS report 08/2015; https://groups.yahoo.com/neo/groups/spectro-l/conversations/messages/17365). Harmanec et al. (A&A, 364, 2000; H2000 hereafter) argued that there are at different times "migrating sub-features" moving across the line profiles which affect the blue and red wings.

On the other hand, our results confirm very well the basic orbital parameter of this binary system (see parameter summary H2000 & Pollmann). So, we are now confronted with the issue of the causes of the observed RV irregularities. The order of magnitude of the RV deviation of the calculated orbital curve is given with the RMS value of 2.19 km/s (Fig. 4).

It is possible that monitoring the RV of the HeI 6678 absorption core of γ Cas (Fig. 5 & 6) will offer an opportunity to observe an "undisturbed" process. The HeI 6678 absorption is formed close to star's photosphere and, therefore, it should be possible to measure RV without restructuring or turbulence effects, as in the outer region of the disk at Hα.

In order to clarify this issue we used some more γ Cas HeI 6678 spectra from the BeSS data base. Fortunately there are useful spectra from the years 2000 to 2011 and some additional spectra in 2015 of different observers, which were very helpful for our analysis.

With the HeI 6678 RV of these spectra we have been able, along with Fig. 2 of the H2000 paper, to design a total overview of the RV time behavior since 1993 (Fig. 7). On the time base of 22 years in Fig. 7 we demonstrate that, with our BeSS data starting from September 2000, we continued the RV process from where the H2000 measurements ended.

The first surprise is that after the RV (H2000) maximum with + 90 km/s (approx. JD 2451300, May 1999), our campaign clearly shows the RV on a more or less constant level between 0 and -22 km/s. This overall RV behavior leads to the question of the physical causes within this ring-like Helium zone, the answers to which cannot be given here.

Fig. 8 shows the RV phase curve of our data from Sept. 2000 until now, whereas Fig. 9 shows the phase curve of H2000 from Sept. 1993 to Sept. 2000 (approx.).With our instruments nowadays we were able to achieve a much better signal to noise ratio (S/N) than H2000, particularly by using spline smoothing (Vondrak, 1969, Bull. Astron. Inst. Czechosl. 20, 349 & Vondrak, 1977, Bull. Astron. Inst. Czechosl. 28, 84).

With our campaign we can confirm in Fig. 8 a clear detectable phase behavior with a period very close to the period of H2000, in spite of very different RV time behavior. In addition, we have to emphasize that with our spectra we achieved a much better RMS than H2000 (approx. factor 2).

Nevertheless it must be noted that our RMS of 3.9 km/s (Fig. 8) does not yet provide such an "undisturbed" RV behaviour, which would be necessary in order to provide a clarification of the "disturbances" of the Hα RV shown in Fig. 3 & 4.

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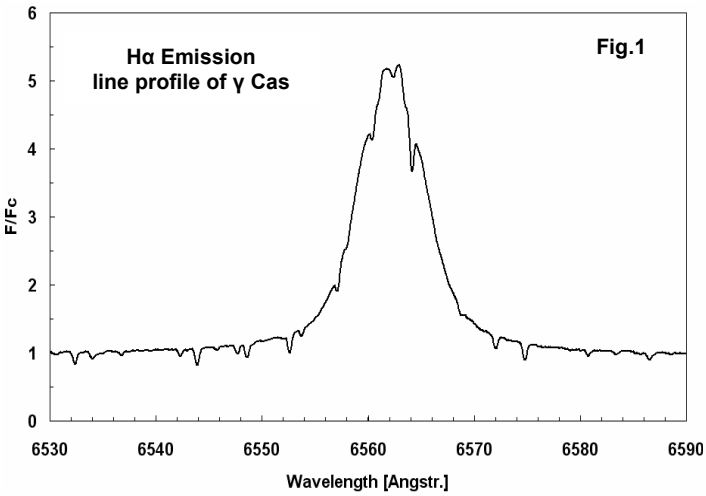
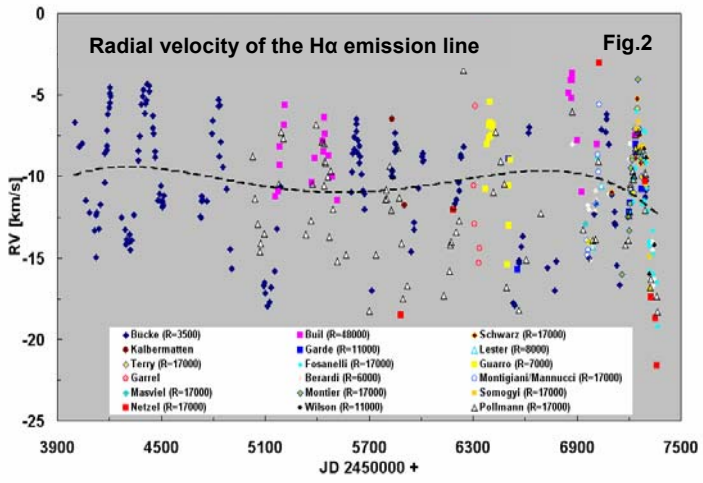
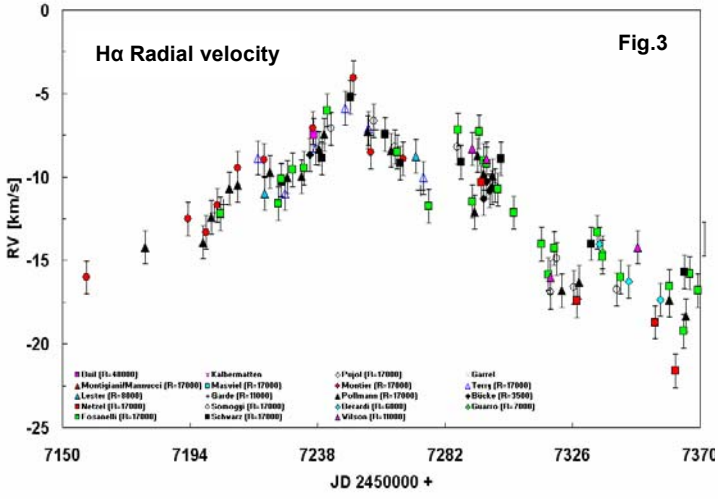
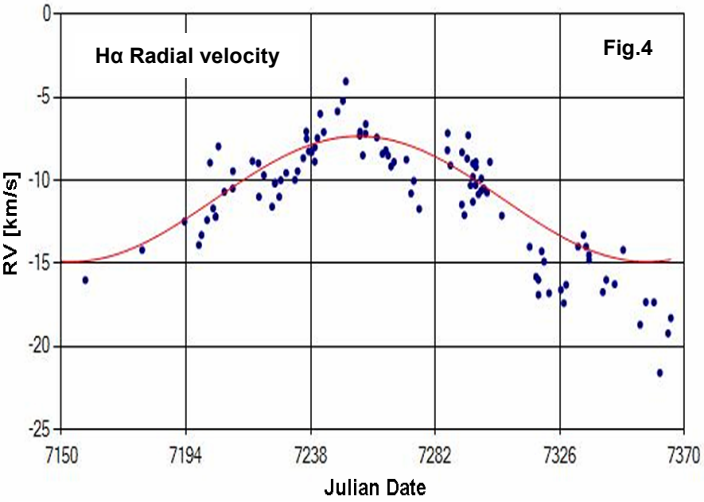


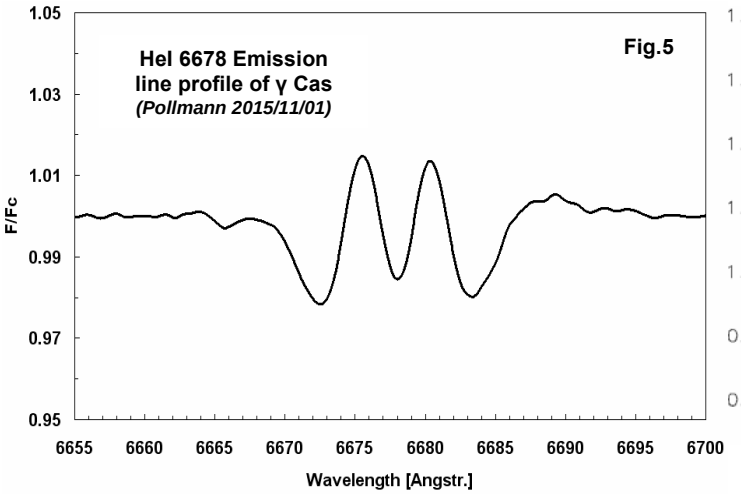

**Parameter Summary** ***(Pollmann, Dec./2015)***

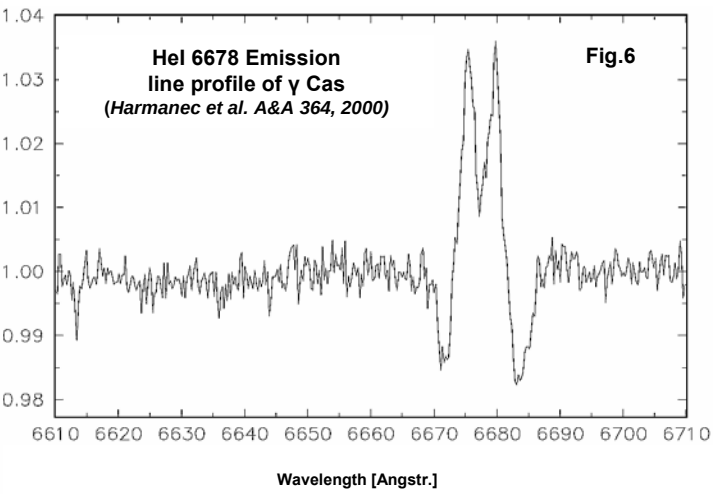
**Hα emission**

**P (d) = 203.406 ± 0.23**
**T0 = 53823.9 ± 2.4**
***e* = 0.028 ± 0.034**
**K1 = 3.89 ± 0.15 km/s**
**RMS = 2.19 km/s**

**Parameter Summary** ***(H2000)***

| **Hα emission** | **HeI 6678 abs. core** |
|---|---|
| **P (d) = 203.59 ± 0.29** | **203.59 fixed** |
| **T0 = 53823.9 ± 2.4** | **50576 ± 16** |
| ***e* = 0.26 ± 0.035** | **0.260 fixed** |
| **K1 = 4.68 ± 0.25 km/s** | **7.0 ± 1.5** |
| **RMS = 1.46 km/s** | **8.95** |



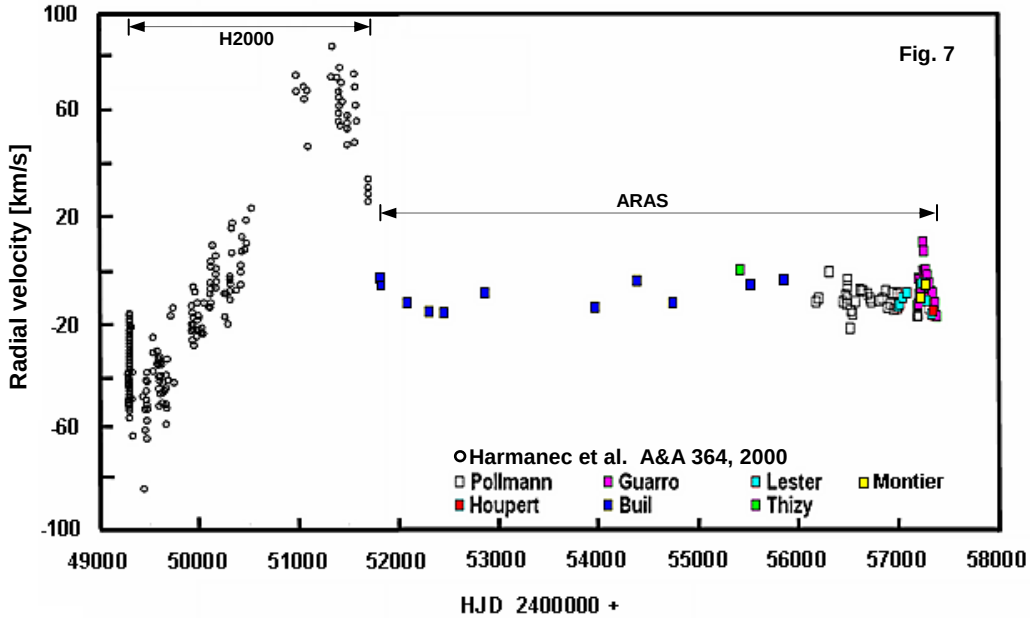
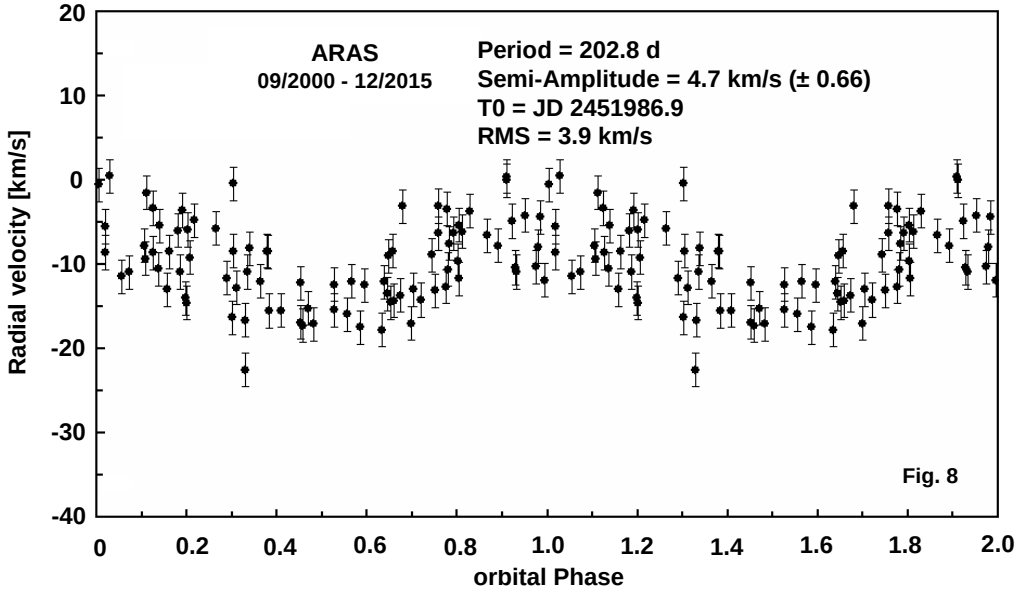
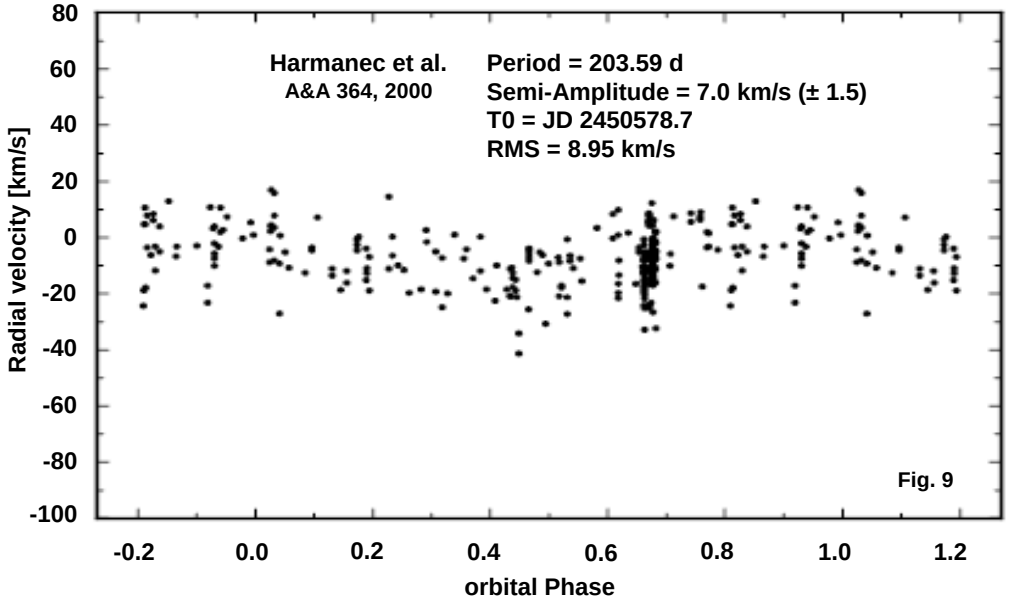


Fig. 7
H2000
ARAS
Radial velocity [km/s]
HJD 2400000 +
Harmanec et al. A&A 364, 2000
Pollmann
Guarro
Lester
Montier
Houpert
Buil
Thizy


ARAS
09/2000 - 12/2015
Period = 202.8 d
Semi-Amplitude = 4.7 km/s (± 0.66)
T0 = JD 2451986.9
RMS = 3.9 km/s
Radial velocity [km/s]
orbital Phase
Fig. 8


Harmanec et al.
A&A 364, 2000
Period = 203.59 d
Semi-Amplitude = 7.0 km/s (± 1.5)
T0 = JD 2450578.7
RMS = 8.95 km/s
Radial velocity [km/s]
orbital Phase
Fig. 9