5.4.2 Equivalent width and disc radii of *HeI* λ6678 and H_α

In the BeSS database, *HeI* λ6678 has occasionally been observed together with H_α λ6563 because both wavelengths are very close in the spectrum. However, both elements are physically formed at different layers of the circumstellar disc of Be stars. *HeI* λ6678 is formed closer to the photosphere of the star at about 2.3 stellar radii, as reported by Stee et al. (1998) compared with the H_α region, which is about 7–19 stellar radii (Slettebak et al., 1992).

From our measurements, we found that the equivalent width of *HeI* λ6678 is proportional to H_α as shown in Figure 5.18. In Figure 5.19, we show that the strength of *HeI* λ6678 was decreased throughout the observation period since 2007 as was H_α. We expect that the multiple increments of *EW* in *HeI* λ6678, which have been explained in the previous section, are probably because of the growth of the disk since decreation disk is never steady (Okazaki, 2007).

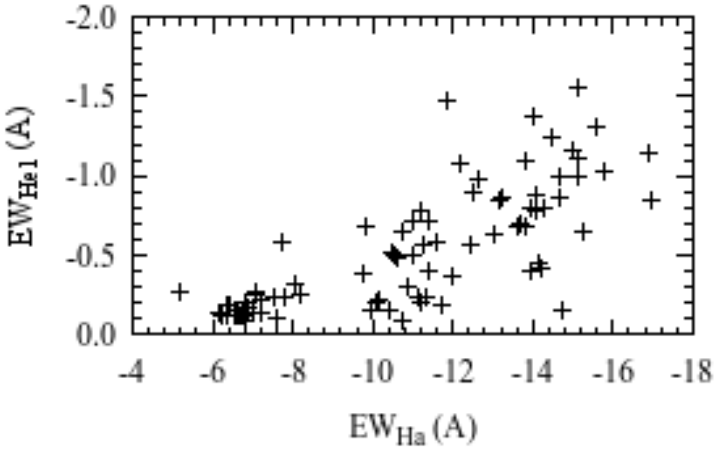

Figure 5.18 - Correlation between equivalent width of H_α and *HeI*λ6678.

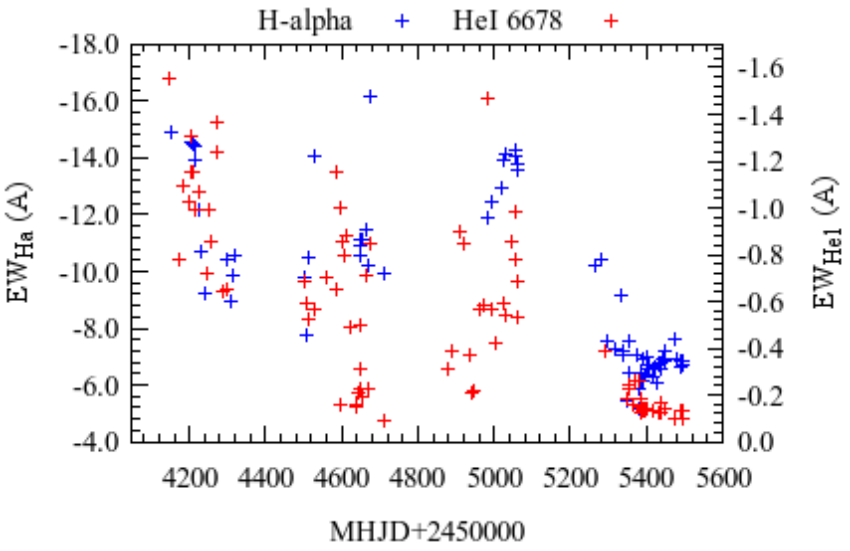

Figure 5.19 – Strength variation of H_α and *HeI*λ6678 emission lines with time.

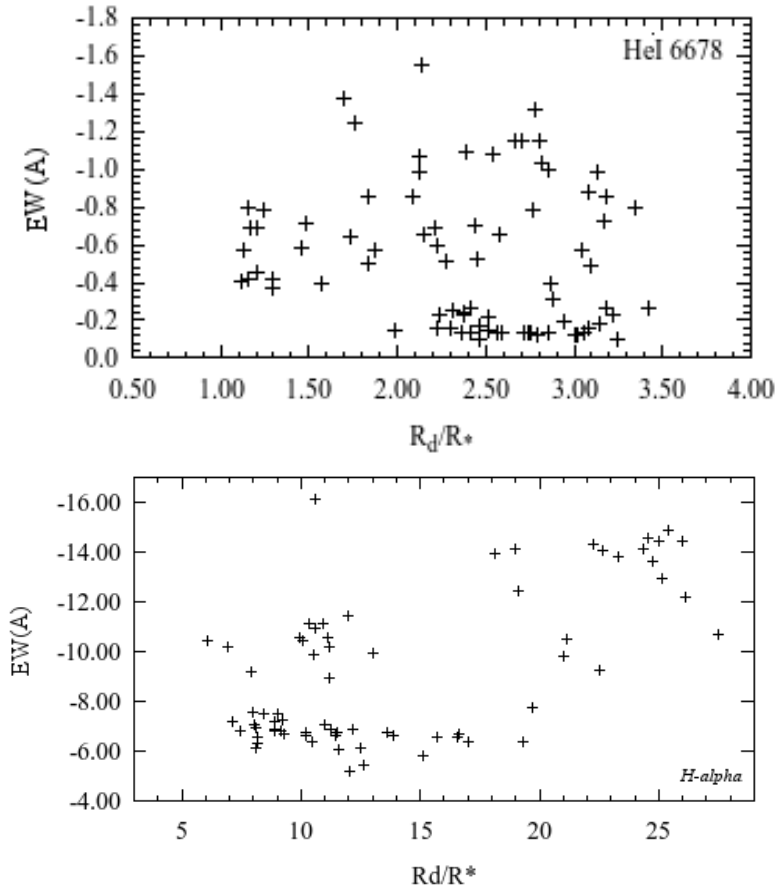

Figure 5.20a – Correlation of disc radii and line strength: *HeI*λ6678 (top) and H_α (bottom).

The relationship between the strength and the disc radii of the *HeI* λ6678 and H_α emitting regions is shown in Figure 5.20a. Both regions exhibit the same correlation; the strength is increased as the disc size is increased. However, in 2010, the disc radii were anti-correlated with the strength for both of the lines. During this year, the *EWs* of *HeI*λ6678 were apparently decreased below 0.3 Å with increasing disc radii. At this strength, the intensity of the line reduced and the profile physically became very small caused difficulty in determining the continuum.

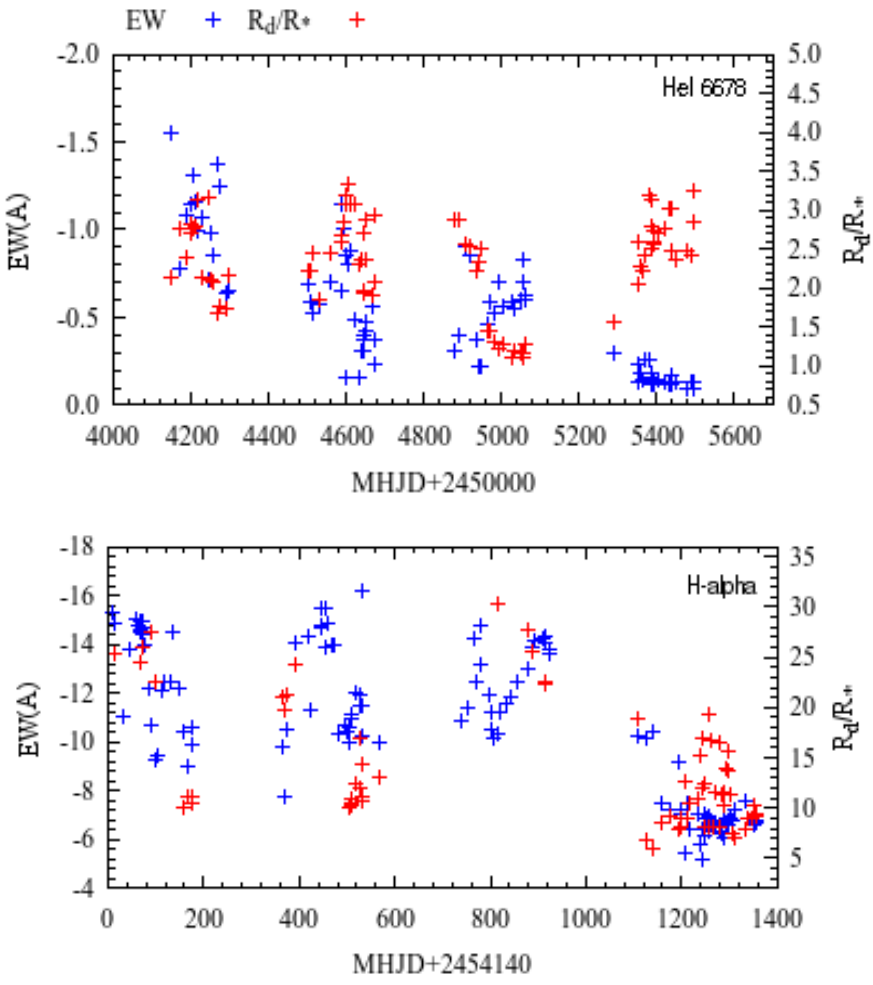

Figure 5.20b – Correlation of the line strength and disc radii: *HeI*λ6678 (top) and H_α (bottom).

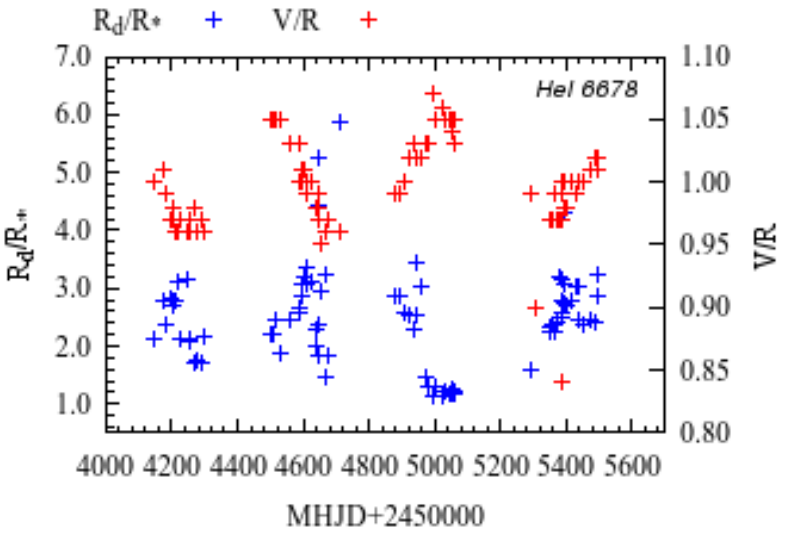

Figure 5.21 – Variation of the disc radii and *V/R* of *HeI*λ6678 emitting region throughout the observation period from 2007 to 2010.

We also analysed the correlation between the variation of disc radii and *V/R* ratio with time for the *HeI* λ6678 region. Figure 5.21 shows that the disc radii were inversely related with the variation of *V/R* ratio, where the disc radii increased with the decreasing of the *V/R* ratio but in 2010, the correlation of those parameters became proportional, probably because of influence from the photospheric region, as this region has been measured very close to the stellar surface.

In this work, we observed that the strong and weak emission lines are correlated in such a way that the weak line had larger ΔV_p than that of the strong line, as shown in Figure 5.22. The weak emission lines correspond to smaller disc radii and thus, the double-peaked profile had a larger ΔV_p. This correlation is consistent with eq.5.2. In this study, we found that the disc radii of *HeI* λ6678 ranged from 1 to 3.5R* (Figure 5.23), whereas the disc radii of the H_α emitting region ranged from ~9 to 28R* (Figure 5.7a). Because of the dependency of the disc radii to peak separation in eq.5.2, the disc radius of $H_\alpha$was often impossible to measure when the profile changed to an asymmetric

single-peaked structure, or the double peaks could not be resolved by the instrument. In contrast, *HeI* λ6678 was represented as a double peak all the time; hence, the disc radius can be measured.

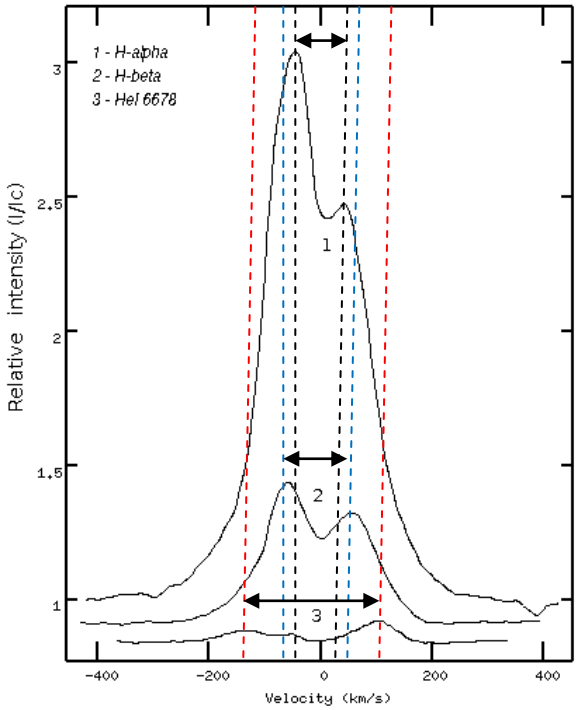

Figure 5.22 – Dashed lines show peak separation of H_α, H_β and *HeI*λ6678 with black, blue and red lines, respectively. Line width of 1< 2< 3; thus,*HeI* had a larger peak separation than H_α and H_β.

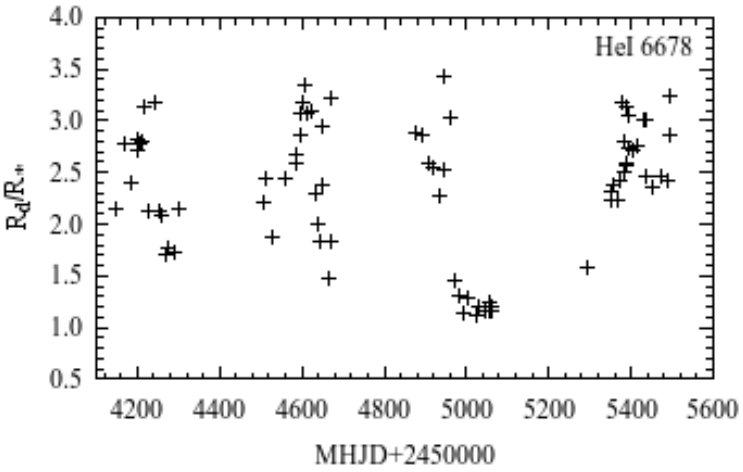

Figure 5.23 –Variation of the disc radii of *HeI*λ6678 emitting region throughout the observation period from 2007 to 2010.