b) H_β emitting region

The behaviour of the line profiles in the inner region of the Be disc of δ-Sco, i.e., H_β, can be summarised as follows. From the graphs depicted in Figure 7.4, we found that the *EWs* of $H_\beta$decreased from 2008 to 2010 as well as H_α and then started to increase in 2011. The *EW* and disc size show two cases of the relationship: firstly, in 2008 and 2009, the region emits a stronger line than in 2010. This stronger line was found correlated linearly with the disc size; secondly, in 2010, we found that the decrease in the line's strength corresponds inversely with the disc size, i.e., a larger disc has a lower strength. The strength increased when periastron approached and became the strongest on the expected day of the closest encounter and then decreased again afterwards. However, the disc radius, as well as *FWHM*, decreased and they became the smallest with the minimum *V/R* ratio at the periastron.

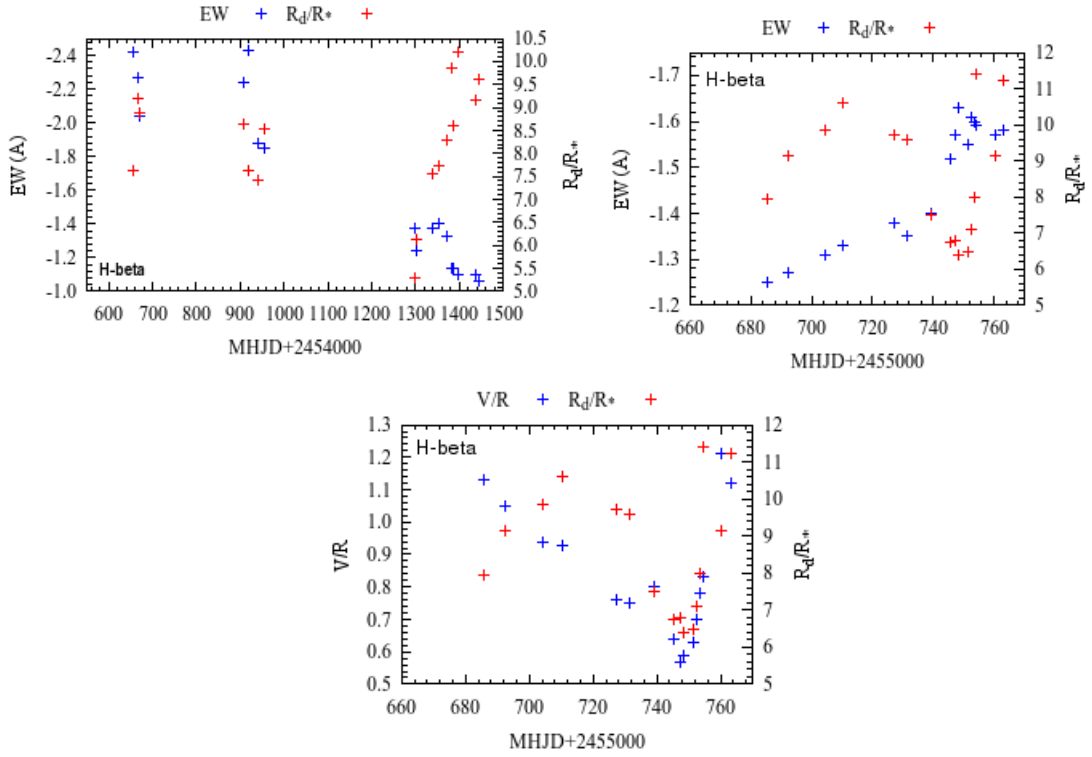

Figure 7.4 – Graphs of the line profiles variations of H_β from 2008 to 2011.

The variations of *EW* and *FWHM* of the line profiles with time in this region show an inconsistency in their correlation, whereas in 2008 and 2009, the data of $H_\beta$were few and thus, it is hard to determine the correlation but it seems to be inversely related; in 2010 the correlation became proportional and in 2011, the correlation again became opposite until after the periastron and then only the *EW* increased with increasing *FWHM*.

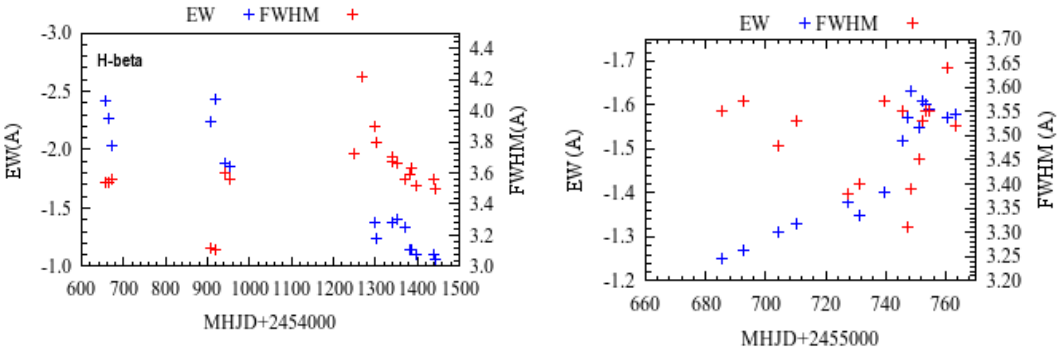

Figure 7.5 – Variation of *EW* and *FWHM* of H_β from 2008 to 2011.

As we can measure the disc radii, we found that the disc is dynamic in a way that it becomes larger when its radial velocity moves towards shorter wavelengths and the *V/R* ratio becomes lower and vice versa. This relation has also been found to apply to the other regions: $H_{\alpha,}$ H_γ and *HeI*λ6678.

c) H_γ emitting region

This region was severely influenced by the underlying photospheric lines in which the emission line appeared inside the photospheric absorption line, as shown in Figure 5.12b. As with the other lines, the line strength in this region is directly proportional to its disc radii. The line also has the same correlation of *V/R* with disc radii as do the other

lines,i.e., a higher *V/R* ratio shows a smaller disc size. These correlations are shown in Figure 7.6.

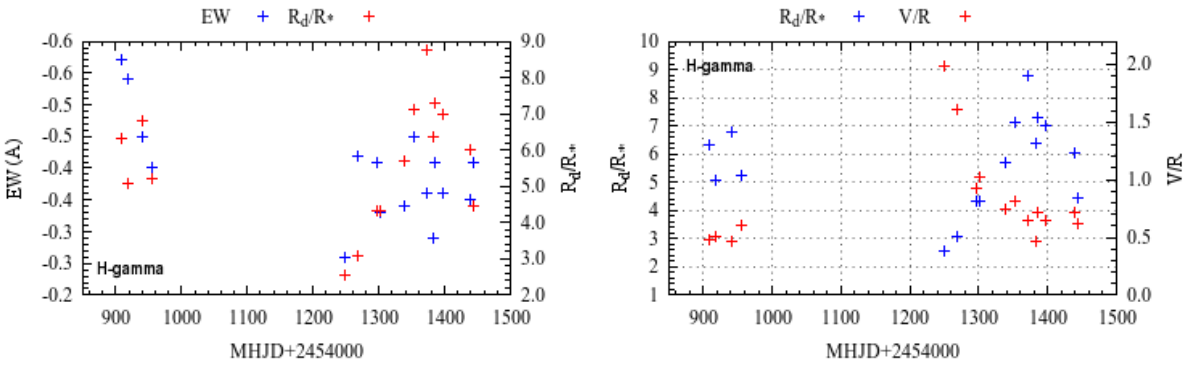

Figure 7.6 – Variation of *EW*, disc radii and the *V/R* ratio of H_γ from 2009 to 2010.

d) *HeI* λ6678 emitting region

In this region, the strength decreased from 2007 to 2010 as well as in other regions. Like the other circumstellar regions, the strength of this region was found consistent with its size from 2007 to 2008 but inversely proportional in 2009 and 2010.

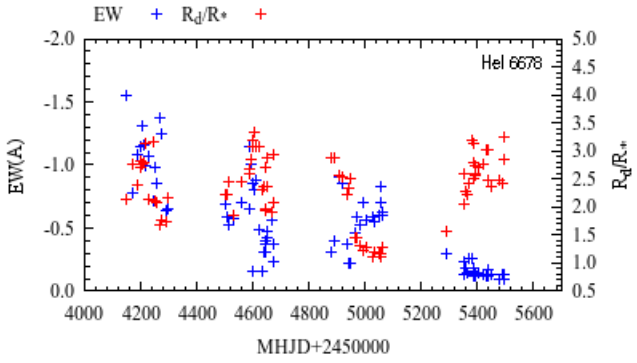

Figure 7.7 – Variation of *EW* and disc radii of *HeI* λ6678 from 2009 to 2010.

Based on the measurement via the double-peaked profile, this region was found the closest to the stellar surface compared with the other circumstellar line regions. We found that the radii of this region vary from about 1.0 to 3.5 stellar radii and that the average was measured at about 2.3 stellar radii *HeI*λ6678. This value is consistent with Stee et al. (1998) when they measured the inner envelope of γ Cassiopeia. As this line is one of the nearest lines to the stellar surface, it is usually influenced by the activity on the stellar surface or photospheric region. From the measurements, it appears that the effect causes the line strength *EW* to be reduced. The decrement in *EW* from 2007–2010 is not only exhibited in this emission line but also in other emission lines: H_α, H_β and H_γ, as shown in Figures 5.7(b) and 5.13(a). Therefore, the evolution of *EW* with time is consistent in most of the disc's regions. This region is correlated with the increase of line strength in other regions of the circumstellar disc. Based on the analysis, as shown in Figure 5.18, we found that this line is consistent with the above relationship. However, in 2009 and 2010, the increase of the disc size was found independent of the line strength.

The profile has often been observed in a triple-peak profile in addition to that of the double-peak profile and that the double-peak profile sometimes shows splitting features. All these kinds of features show that δ-Sco has a multiple system in addition to its well-known companion, the 8M⊙ companion.