Chapter 7

Discussion and Conclusions

7.1 INTRODUCTION

δ-Sco was only categorised as a Be star quite recently in the 1990s when the star showed an emission H_{α} line on the flanks of an absorption core. This star has been known as a binary system from as early as 1901, when observed by Innes during a lunar occultation. Recent work on the binarity of the star discovered that the mass of the primary is 12.4 +/- 0.8 $M_{\odot}$ and that of the secondary star is 8$M_{\odot}$ with a spectral type of B2 (Tango et al., 2009). The orbital period of 10.817 years has been measured with a high eccentricity of 0.94 (Tycner et al., 2011). This high eccentricity will create a moment of a periastron passage where both stars are at their smallest separation. Estimations from the latest work expect that the stars would be separated by 6.14 +/- 0.07 milliarcseconds (mas) or 14 stellar radii (Tycner et al., 2011).

It became the interest of this study to investigate the disc characteristics of this star during the periastron passage because at that moment, the interaction between the secondary and the primary stars could probably induce the transformation of δ-Sco into a Be star. One of the objectives of this work was to study the spectral profile characteristics of the star in an optical range and their relation to the mechanism for Be phenomenon in δ-Sco, especially when the star went through its periastron passage.

In the first part of the analyses, we investigated the Balmer lines' regions, which consist of H_α, H_β and H_γ. The basic concept in the formation of the emission and absorption lines in the optical range of δ-Sco as a Be star can be illustrated as follows:

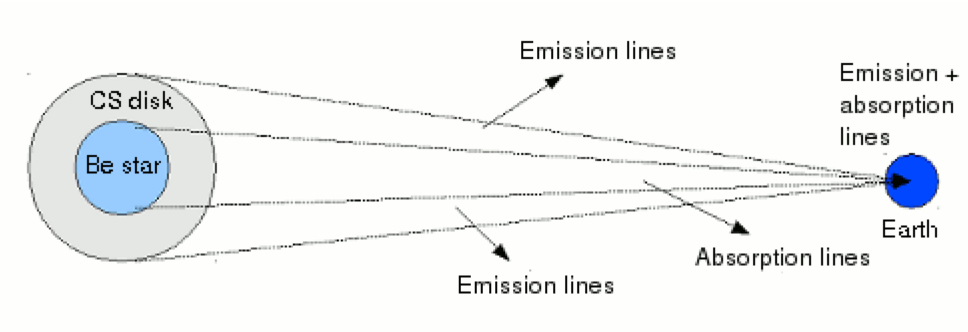

Figure 7.1 - Schematic diagram of the concept of emission and absorption lines in Be star.

We believe that the outer disc of δ-Sco is geometrically thin, which follows the laws of a Keplerian disc. The disc has been known to be inclined with respect to the line of sight at 38 +/- 5 degrees (Miroshnichencko, 2001), whereby a double-peaked line profile is formed in this region. The double-peaked profile can be used to indicate the approaching and receding parts of the rotating circumstellar disc, which are denoted as violet (V) and red (R) components, respectively. Acting as a Keplerian disc, the peak separation can be correlated with the outer radius of an emitting region with respect to the stellar radius. The appearance of the double-peaked profile offers some measurements on the disc profile, such as the *V/R* ratio and relative disc radius.

7.2 DISC DEVELOPMENT AND MOTION

Occasionally, as shown in Chapter 5 of this work, in the spectra of δ-Sco originating from the extended circumstellar disc, a high resolving power instrument of 0.1A/pixel has detected the double-peaked profile. The characteristics or behaviours of the lines' profiles in the circumstellar disc of δ-Sco are summarised in the following.

a) H_α emitting region

From the analyses of the H_α line, as shown in Figure 7.2, we found that the relative disc radii *Rd/R** were directly proportional to the line's strength *EW*, whereas the line's strength itself has been found inversely proportional with the line broadening *FWHM*. In general, the *EW* can be used for an indication of the activity in the region from where the line originated. In this work, the strength of the H_α line was found to have decreased with time from 2007 to 2010 but towards the end of 2010 and into 2011, the strength began to increase, even after the event of periastron passage. Based on the measurements on the disc's profile, we found that a higher *V/R* ratio or *V>R* corresponds to a smaller relative disc radius with the line shifted towards a longer wavelength.

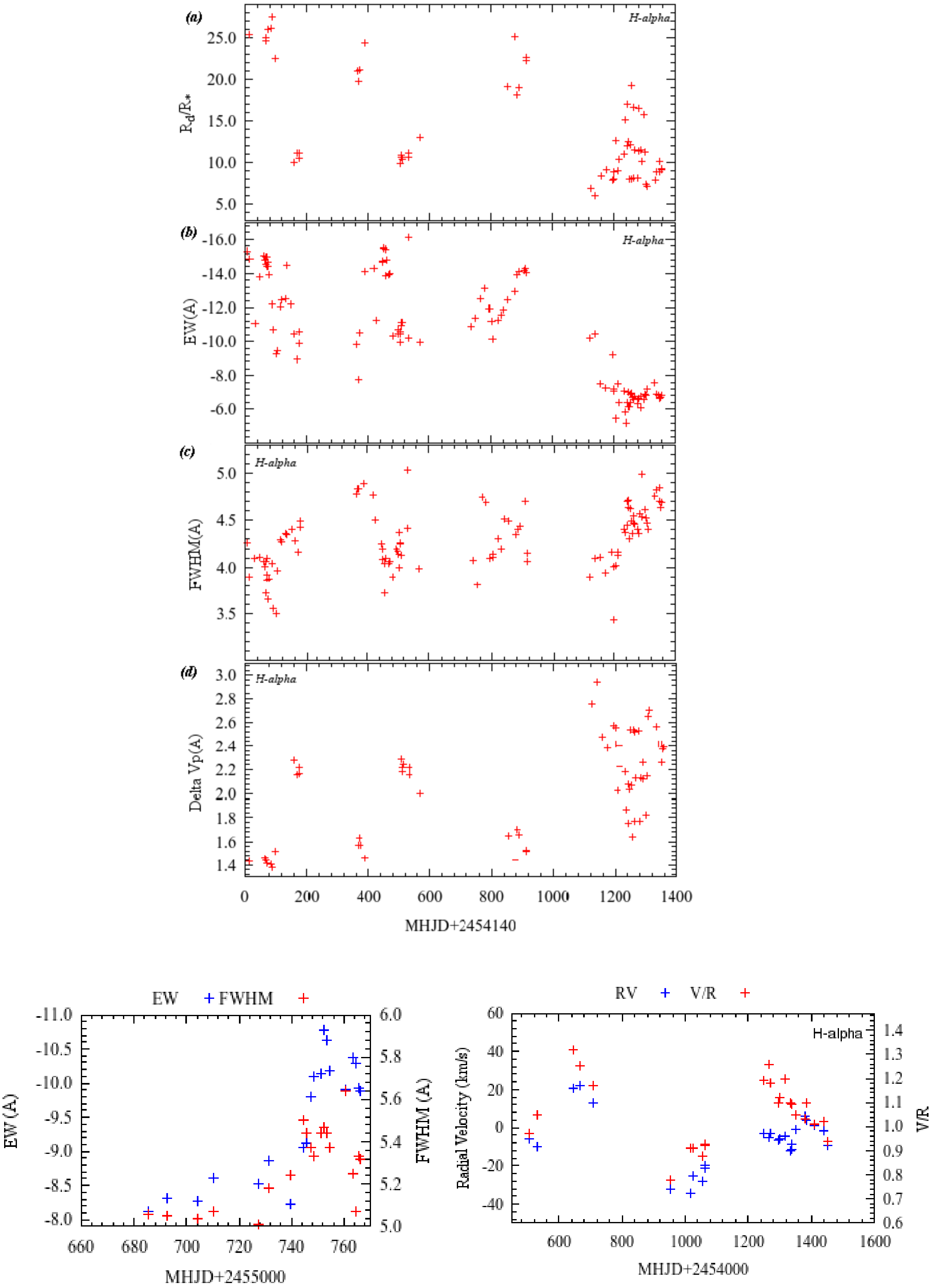

Figure 7.2 – Variations of $H_\alpha$line profiles from 2007 to 2011

In Table 7.1 and Figure 7.3, the selected profiles that have the same spectral dispersion have been listed to show the evolution of this line from 2007 to 2010. We estimates that the disc's size can become larger than 30 stellar radii, the profile of which shows the highest relative intensity and the widest line broadening, as well as the greatest strength based on the data from 2007 to 2010. The phi values of each profile in Figure 7.3 are referring to the phase of periastron with respect to the orbital period. In Table 7.1, the error analysis was included to show that the errors were very small and that they should not affect the measurement values of the line profile and thus, can be neglected.

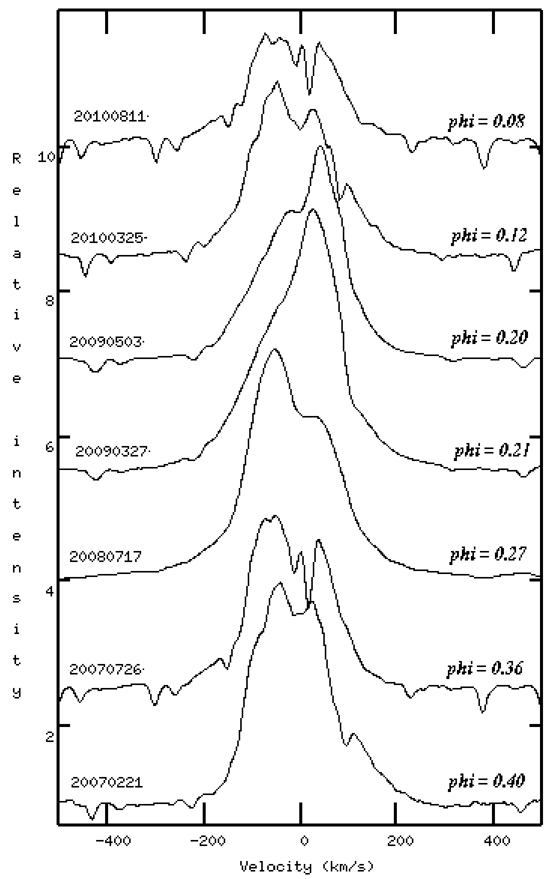

Figure 7.3 – Evolution of H_α line profile from 2007 to 2010.