**Spectroscopy of the growing circumstellar disk in the δ Scorpii Be binary**

(see also publication in A&A 408, 305-311, 2003)

The emisson line profiles seen in the spectrum of δSco are very similar to those of classical Be stars and are most likely formed in an flattend, probaly quasi Keplerian, circumstellar disk. The structure of such disks has not been observationally studied very well. Only a very few Be stars have recently developed or lost their disks. Such observations are very importend to investigate the mechanisms of disk formation and evolution.

Visual and photoelectric observations reveal that dSco had a γCas-type outburst during 2000 July to 2001 January and beyond which was accompanied by Ha-emission. The start of the outburst coincided with periastron passage of the secondary in the speckle binary system.

In June and July 2000 visual observations showed a slow increase in brightness typical of a γCas-type outburst. Further visual observations were made regulary and these were later supported by photoelectric observations.

The relationship between the optical outburst and the Hα-emission is not clear. Hα-emission has been at some level for all of the past cycle, about ten years, but was apparently absent during the previous cycle. Apart from the current outburst and the possible event in 1958 the luminosity has apparently remained constant throughout most of both cycles. The current optical outburst is unlike anything previously seen, in terms of both magnitude and duration. The Hα-emisson is also stronger than previously observed, but in detail it does not shows a strong correlation with the brightness variations.

dSco provides a nice opportunity to study the ongoing disk formation process in detail. It is bright (allowing one to obtain high-resolution spectroscopy with relatively small telescopes) and can be observed from both hemispheres nearly 9 month a year.

For low-dispersion spectroscopy I used a 20-cm Cassegrain-Schmidt telescope at the Observatory of the Cologne-Stargazer´s Association equipped with my grating-spectrograph and a 768x512 pixel CCD-chip, which provide a 0,395 Angstr./pixel reciprocal dispersion, was employed (fig.1).

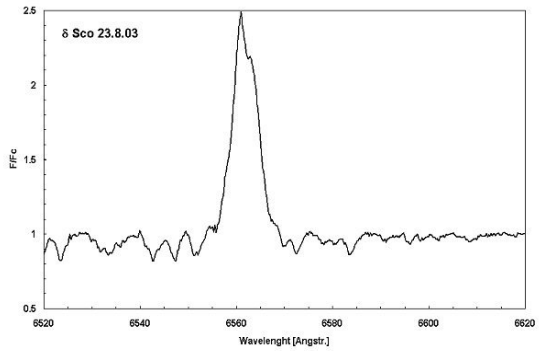



Fig. 1: Hα spectrum of δ Scorpii

More than 150 Ha-spectra were obtained. Figure 2 shows the Ha-equivalent width (EW) behavior in the spectra of dSco. The observations obtained at different sites are denoted by the following symbols: blue full circles - observations of the Ritter-Observatory,Toledo(Ohio), yellow full circles - observations of Christian Buil, (France), red full circles - my observations.

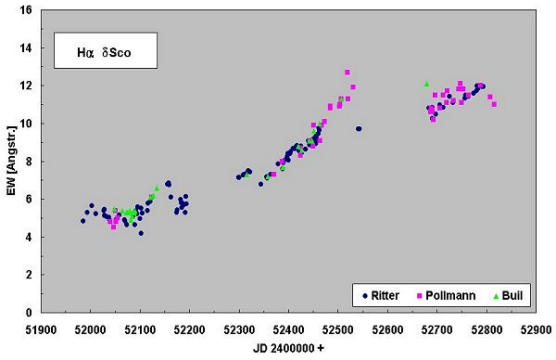



Fig. 2: Temporal development of the Ha-emission

The growing EW of Hα suggest that the disk is expanding. This is due to a larger contribution of more distant and more slowly rotating matter to the observed profile. The 2-year (March 200 - May 2003) spectroscopic monitoring of dSco resulted in the following major findings:

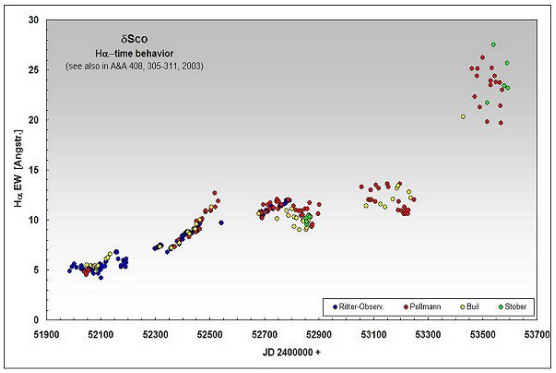
- We observed a steady growth of the disk which manifests itself by a

continuous strengthening of the Hα emission line.

- Short-term emission-line variations seem to be due to outbursts of matter ejection from the stellar surface into the disk. The outbursts are most likely also responsible for the brightness fadings, seen after corresponding line intensity increases.
- The disk is probaly Keplerian with an outer radius ~ 10 R*, and seems to continue to grow in both density and size.

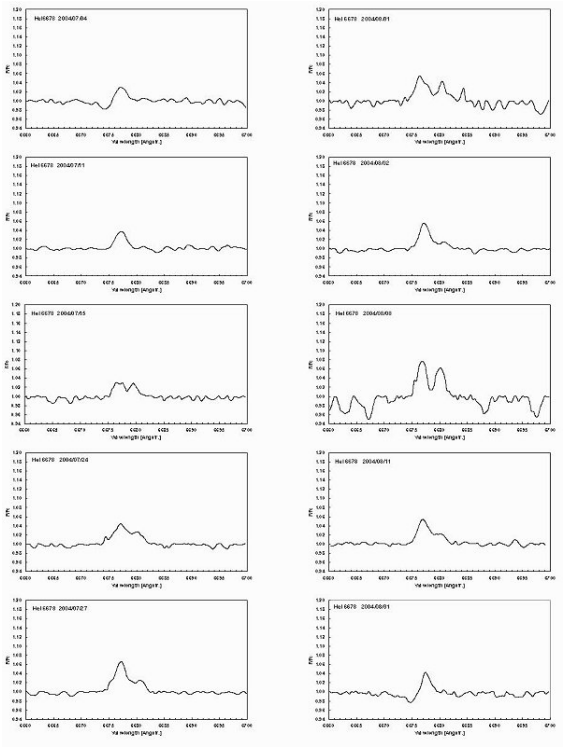
The current disk development of δ Sco

Since August 2004 the disk development had an enormous increase. The Hα–equivalent width increased in the meantime up to 25 Å.

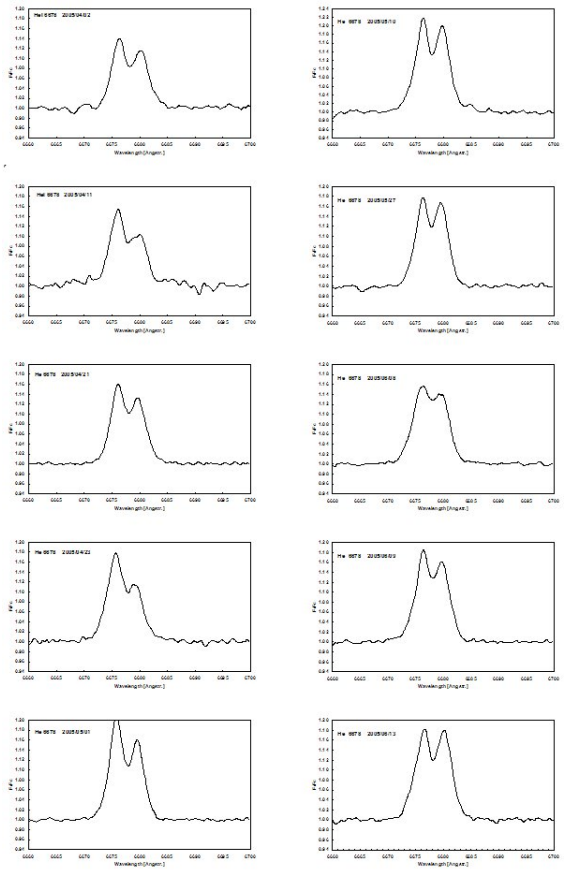


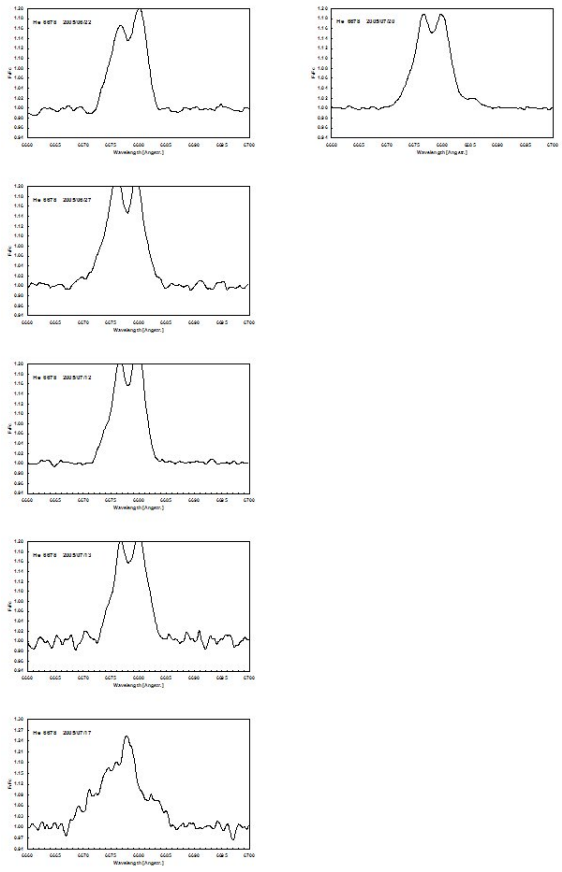

In similar way also increased the intensity of the HeI6678-emission.

The HeI 6678 line profile has P Cyg-type. This suggests that we see some optically-thick outflow. In other words, there is a lot of matter in the line of sight. This is very interesting since the inclination angle of the circumstellar disk is about 45 degrees. In order to see outflowing matter in the line of sight, the outflow should take place within broad range of stellar latitudes. It would be very important to constrain this event in time (see the following spectrum series from 2004/07/04 - 2005/07/20).

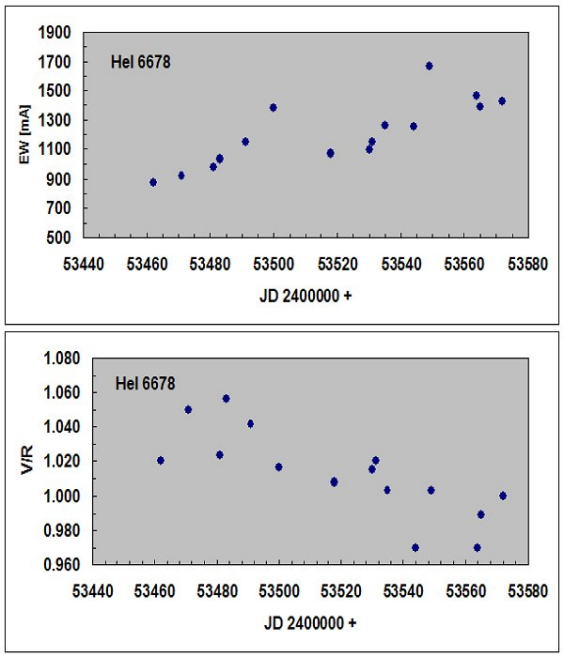


Since beginning of the visibility period starting from 04/2005 the emission strength increased enormously.





The time behavior of equivalent width (mÁ) and V/R-ratio starting from April 2004 shows the following illustration.




Ernst Pollmann, 17. August 2005