Spectroscopic and Spectropolarimetric Observations of Herbig Ae/Be Stars PDS 37 and PDS 27

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Introduction

Herbig Ae/Be are pre-main sequence stars with masses roughly between 2 and 10 solar masses, and they are optically visible. They bridge the gap between low and high mass stars. Their cicumstellar environment plays a key role in the process of star formation.

Spectropolarimetry is a very powerful technique that can be used to study the circumstellar environment. It probes very small spatial scales of stellar radii. The technique is based on the concept that the free electrons in the ionised hydrogen region polarise light causing a change in polarization across the lines (line effect). Fig 1 explains the line effect.

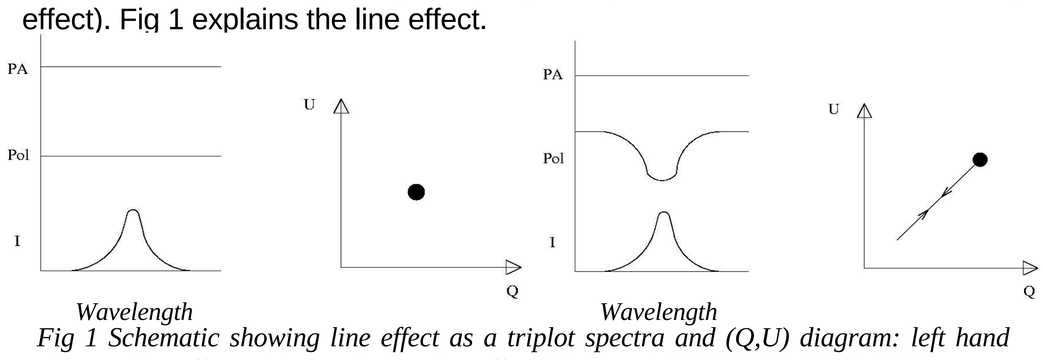

Fig 1 Schematic showing line effect as a triplot spectra and (Q,U) diagram: left hand side; no line effect, right hand side; line effect (Vink et al. 2002MNRAS.337..356V).

Results

We present the results of spectropolarimetric and spectrometric observations of PDS 37 and PDS 27 both of which have not been previously studied in depth. The data were obtained with FORS2 and the X-Shooter spectrograph, both of which are mounted at the VLT, Chile.

The spectra obtained cover the entire optical range. This coverage shows many lines such as hydrogen, helium, Ca II, iron, sodium and oxygen. Fig 2 shows some of the observed lines. The center of the line is often seems to be shifted towards the red side. H-alpha has very large equivalent width and a line contrast of approximately 20, indicating a large amount of ionized gas. Most Fe II lines are double peaked in PDS 37 as a possible indication of inclined disk. The strength of three well known accretion tracers H-alpha, H-gamma, and [O I] is used to estimate the accretion rates.

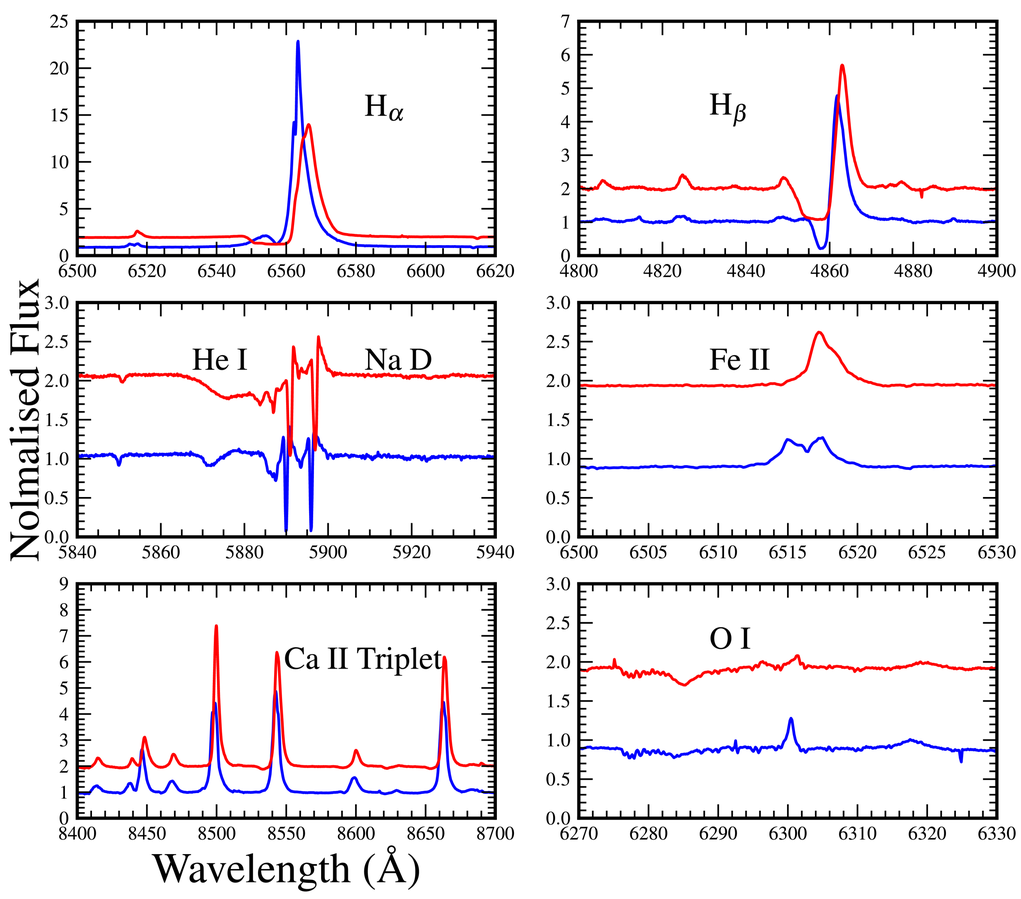

Fig 2 Some of the observed optical lines, blue (PDS37), red (PDS 27).

PDS 27 shows a large variability in H-alpha in two epoch. Fig 3 shows the comparison of X-Shooter and FORS2 data

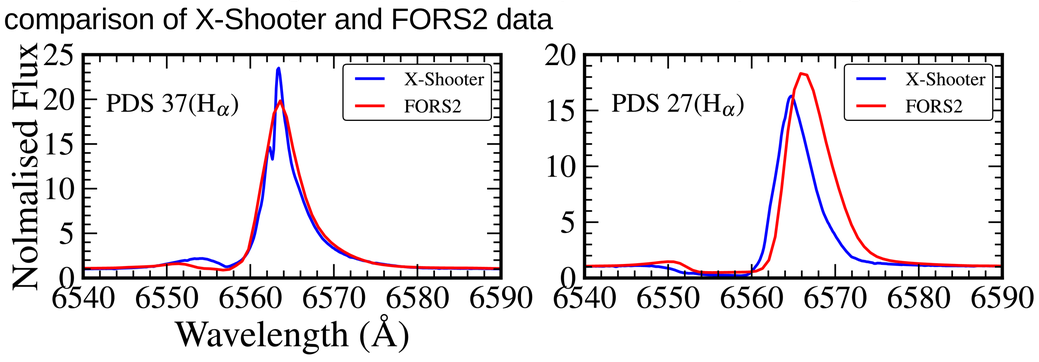

Fig 3 The comparison of X-Shooter and FORS2 data.

Diffuse Interstellar bands (DIBs) are seen in their spectra. Their origin comes from the molecules present in the Interstellar Medium (ISM). The strength of DIBs is used to measure the extinction due to the ISM, Fig 4 shows some of the observed DIBs.

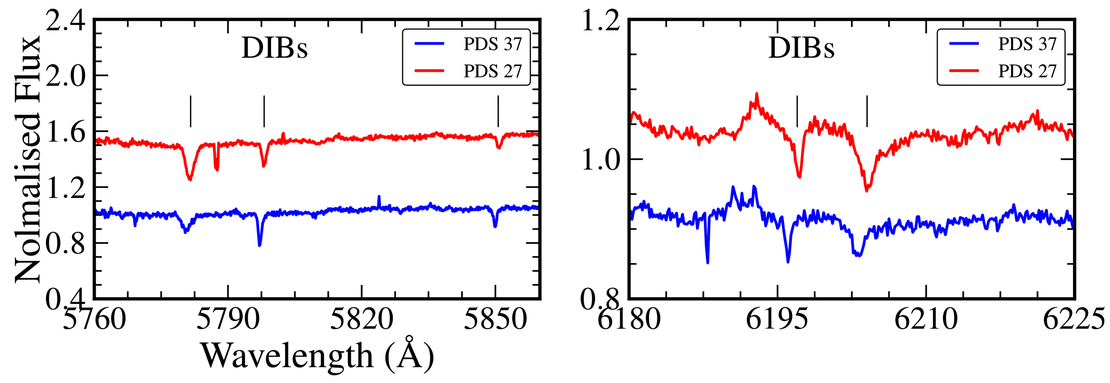

Fig 4 Some of the observed DIBs.

We investigate line spectropolarimetry of H-alpha, H-Beta and Ca II. Ca II shows no clear line effect. As shown in Fig 5 there is a strong line effect in polarization from polarization spectra and (Q,U) diagram, indicating the presence of disks.

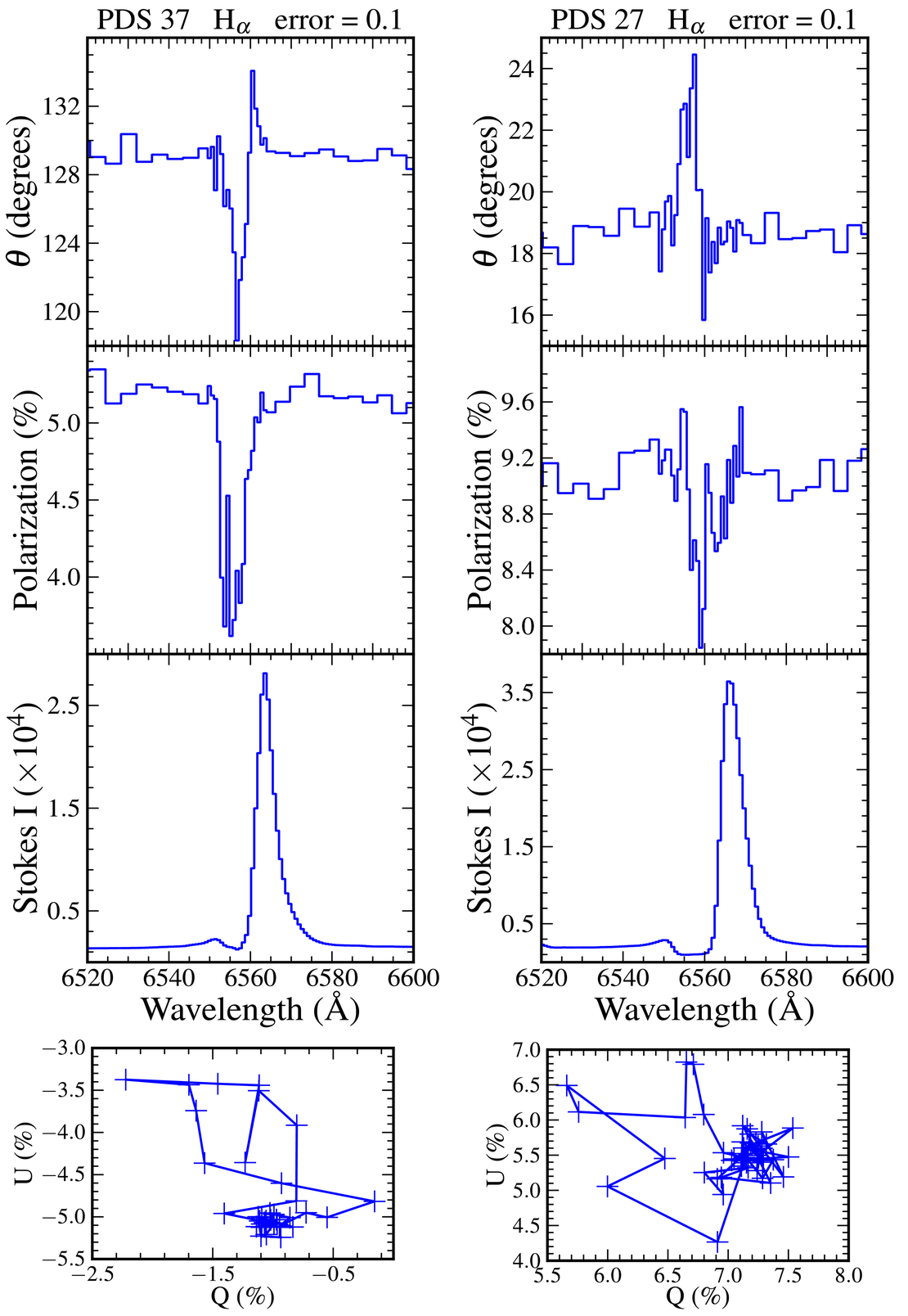

Fig 5 polarization spectra of PDS 37 and PDS 27 and their (Q,U) diagram below the triplot. The Stokes intensity is shown in the lowest panel, polarisation in the middle, while the position angle in the upper panel.

Conclusion

Most observed lines are in emission with P-Cygni profiles in some cases, indicating the possible presence of outflows. Both objects have a large extinction and accretion rates due to the fact that they are young objects and still have a large amount of material around them. DIBs can only provide extinction due to the ISM. H-alpha shows a clear line effect across the absorptive component while the emission has the same polarization as the continuum, suggesting the wind material causes the polarization. The amplitude of the change in polarization is higher in PDS 37 than in PDS 27 as we predict more intrinsic polarization in more inclined disks.