FULL TITLE
*ASP Conference Series, Vol. **VOLUME**, **YEAR OF PUBLICATION***
NAMES OF EDITORS

Simultaneous Doppler maps of IP Peg in outburst

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Abstract. IP Pegasi is an eclipsing dwarf nova lying above the period gap with an orbital period of 3.8h. It is the first cataclysmic variable to show evidence of spiral arms in its accretion disc. We present new time-resolved echelle spectroscopy observations of IP Peg, covering the 3900-7700Å range. This allows us to construct simultaneous Doppler Maps in 9 emission lines.

Observations

Using EMMI on ESO's NTT, we obtained phase-resolved echelle spectroscopy of IP Peg in August 1999, when the system was in outburst. Our series of 39 spectra, each with an integration time of 300s, extends for more than 5.4 hours, i.e. 1.5 orbital period. The large wavelength coverage, approximately from 3900 to 7700Å, provides us with several emission lines whose simultaneous study allows us to probe in detail the structure of the accretion disc and the contribution of the secondary.

The spectra were reduced using the echelle package routines in IRAF, while the extraction of the orders and the wavelength calibration were performed by the echelle package reduction task doecslit. The continuum contribution was subtracted by fitting a cubic spline to the appropriate parts of each order in each spectrum.

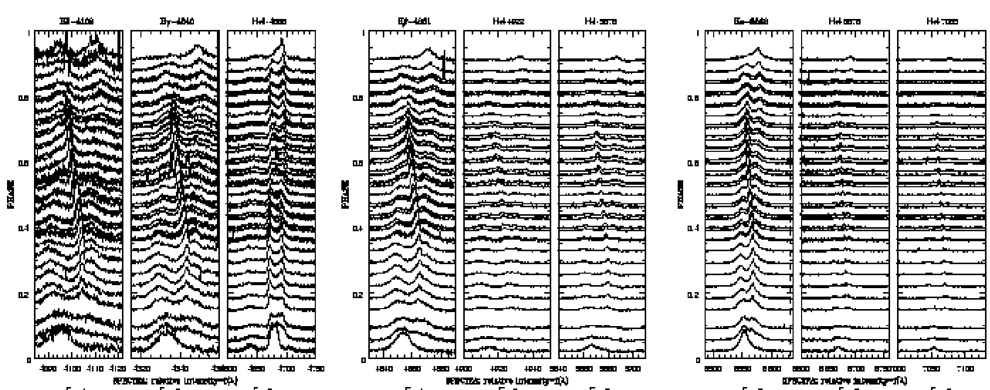

Figure 1. Phase folded spectra of the 9 most prominent emission lines

Analysis

IP Peg in contrast to other dwarf novae does not develop absorption lines during outburst (Piche & Szkody, 1989). A probable explanation could be its high inclination i≈81° that reduces the contribution of the accretion disc absorption lines. From the output spectra no absorption lines were identified, while the 9 most prominent emission lines were selected for further studying. These include the Balmer series Hα, Hβ, Hγ, Hδ, four HeI lines with wavelengths 7065, 6678, 5876, 4922Å and one HeII line at 4686Å. The phase folded spectra of all the selected emission lines are plotted in figure 1. The orbital ephemeris for the calculation of the corresponding phases was taken from Wolf et al. (1993).

In figure 1, we detect the characteristic S-wave of a low-velocity emission from the secondary, which reaches maximum at phase 0.5 when the secondary is seen face-on. We also see a clear variation in the line profiles and in particular a variation of the separation between the red and blue-shifted emission peaks originating in the accretion disc.

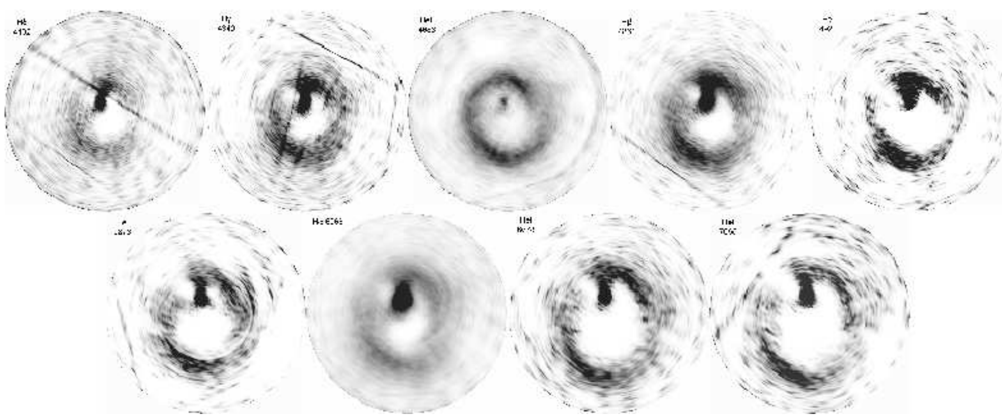

Figure 2. Doppler maps of the corresponding lines of figure 1

As a next step we made a preliminary attempt to apply Doppler imaging on our unique set of spectra. Using Henk Spruit's code (Spruit 1998, http://www.mpa-garching.mpg.de/~henk/pub/dopmap),we constructed Doppler maps (figure 2). Despite some clear artifacts, which are, among others, caused by prominent spikes near the emission lines (as seen in some cases in figure 1) the two spiral arms are visible in each of the Doppler maps. Depending on the emission line the intensity of the spiral arms as well as of the secondary star varies. The comparison between these different simultaneous maps will bring invaluable information on the source of the spiral arms and the structure of the accretion flow. This work is now in progress.

References

Piche, F. & Szkody, P. 1989, AJ, 98, 2225
Spruit, H.C. 1998, astro-ph/9806141
Steeghs, D., Harlaftis, E. T. & Horne, K. 1997, MNRAS, 290, L28
Wolf, S. et al. 1993, A&A, 273, 160