Contrib. Astron. Obs. Skalnaté Pleso **38**, 447 – 448, (2008)

Magnetic fields in X-ray emitting A-type stars

C. Schröder[1], S. Hubrig[2] and J.H.M.M. Schmitt[1]

[1] *Hamburger Sternwarte, Gojenbergsweg 112, 21029 Hamburg, Germany*
[2] *ESO, Casilla 19001, Santiago 19, Chile*

Received: November 22, 2007; Accepted: February 20, 2008

Abstract. A common explanation for the observed X-ray emission of A-type stars is the presence of a hidden late-type companion. While this hypothesis can be shown to be correct in some cases, there is also evidence suggesting that low-mass companions cannot be the proper cause for the observed X-ray activity in all cases. Babel and Montmerle (1997) presented a theoretical framework to explain the X-ray emission from magnetic Ap/Bp stars, focusing on the A0p star IQ Aur. We test whether this theoretical model is capable of explaining the observed X-ray emissions. We present observations of 13 A-type stars that have been associated with X-ray emission detected by ROSAT. To determine the mean longitudinal magnetic field strength we measured the circular polarization in the wings of the Balmer lines using FORS 1. Although the emission of those objects with magnetic fields does fit the prediction of the Babel & Montmerle model, not all X-ray detections are related to the presence of a magnetic field. Additionally, the strengths of magnetic fields do not correlate with the X-ray luminosity and thus the magnetically-confined wind shock model cannot explain the X-ray emission from all investigated stars.

Key words: stars: magnetic fields – stars: activity – X-rays: stars

1. Observations

The observations were carried out on August 28th 2006 with FORS 1 at the VLT Kueyen. This multi-mode instrument is equipped with polarization analyzing optics comprising super-achromatic half-wave and quarter-wave phase retarder plates, and a Wollaston prism with a beam divergence of 22″ in standard resolution mode. The grisms 600B and 1200B were used, which cover all the H Balmer lines from Hβ to the Balmer jump. Most stars were observed with the grism 600B at a spectral resolution of 2000. Since we had only one observing night, we decided to observe only the two most promising targets with the grism 1200B at a resolving power of $R \sim$4000 and a blue limit at 3885 Å. A more detailed description of this technique was given by Hubrig *et al.* (2004 a, b).

2. Results

Out of 13 stars, seven are likely to be weakly magnetic. Magnetic fields in HD 147084, HD 148898 and HD 159312 were detected at 3σ level (see Fig. 1),

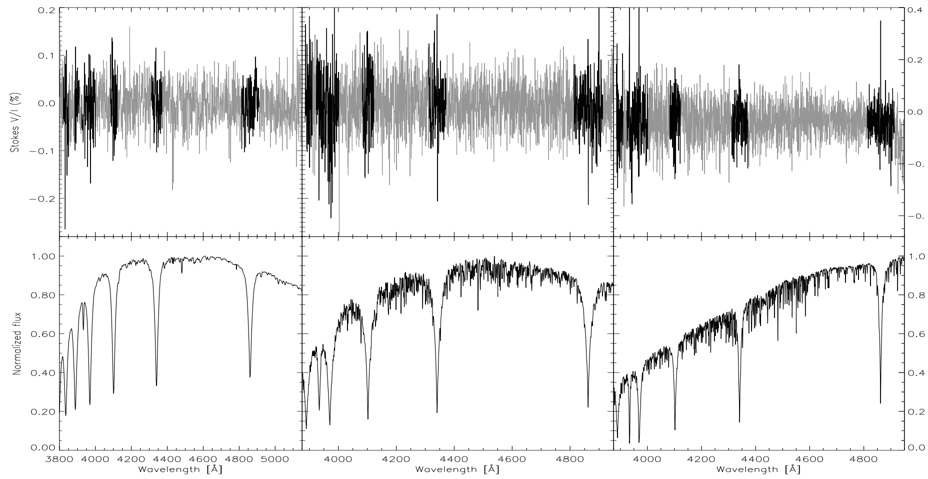

Figure 1. Stokes V/I and normalized spectra of HD 159312, HD 148898 and HD 147084, which have magnetic fields detected at a 3σ level. The black areas in the upper row indicate the regions used for determination of the magnetic fields from Balmer lines.

while for HD 174240 and HD 224392 they are detected at 2σ level. For HD 186219 and HD 217186 detections were made just below the 2σ level. The measurements for the five stars HD 163336, HD 172555, HD 186219, HD 217186 and HD 224361 yielded no detection, but a close inspection revealed Zeeman features in several lines in the Stokes V spectra. These stars are therefore promising targets for further observations. Only HD 159217 showed no sign of a magnetic field. We found no correlation between the X-ray luminosity and the measured magnetic field strength. We have to note that because of the strong dependence of the longitudinal field on the rotational aspect, its use in characterising actual field strength distributions is rather limited (Hubrig *et al.*, 2007). This can be overcome with additional observations to sample various rotation phases. On the other hand, those stars with a detected magnetic field possess X-ray emission which fits the predicted values from the model by Babel & Montmerle.

References

Babel, J., Montmerle, T.: 1997, *Astron. Astrophys.* **323**, 121

Hubrig, S., Kurtz, D.W., Bagnulo, S., Szeifert, T., Schöller, M., Mathys, G., Dziembowski, W.A.: 2004 a, *Astron. Astrophys.* **415**, 661

Hubrig, S., Szeifert, T., Schöller, M., Mathys, G., Kurtz, D.W.: 2004 b, *Astron. Astrophys.* **415**, 685

Hubrig, S., North, P., Schöller, M., Mathys, G.: 2007, *Astron. Nachr.* **328**, 475