Hot Star Workshop III: The Earliest Stages of Massive Star Birth
ASP Conference Series, Vol. 267, 2002
Paul A. Crowther, ed.

Are all Young Stars Disc Accretors?

Jorick S. Vink, J. E. Drew

Physics Dept. Imperial College of Science, Technology & Medicine, Blackett Laboratory, London, SW7 2BZ, UK

T. J. Harries

Astrophysics Group, University of Exeter, Stocker Rd, Exeter, EX4 4QL, UK

R. D. Oudmaijer

Department of Physics and Astronomy, University of Leeds, Leeds, LS2 9JT, UK

Abstract. We demonstrate the importance of Hα spectro-polarimetry in constraining the geometry of Herbig Ae/Be stars. We find that discs are common in Herbig Ae and Be stars, although different polarization signatures may imply different modes of accretion.

1. Method of Hα spectro-polarimetry

We now understand how low mass stars evolve through cloud collapse and magnetically-channelled disc accretion, but whether higher mass stars are also disc accretors is as yet unknown. To answer this question, we need observations probing the near-star geometry of higher mass stars.

Until sub-milliarcsecond imaging becomes possible, Hα spectro-polarimetry is the most powerful technique to explore the first few stellar radii around young stars. The method is based on the expectation that the Hα emission – formed over a large volume in a circumstellar medium – undergoes less electron scattering than the stellar continuum. As the line is then less polarized than the continuum, a change in the polarization across the line occurs – we refer to this as the classical line-effect (analogous to that seen in classical Be stars).

2. Results for the Herbig Ae/Be stars

Figure 1 shows the polarization spectrum (middle panel) for the typical Herbig Be star MWC 1080. Note the presence of the classical line-effect – depolarization across the line – implying that the electron-scattering region is not spherically symmetric, but that the geometry is flattened, i.e. disc-like.

In Fig. 2, the polarization signature (middle panel) of MWC 480 is more complicated, and is at variance with the simple depolarization picture described above. The data for this and other Herbig Ae stars may suggest the presence of a

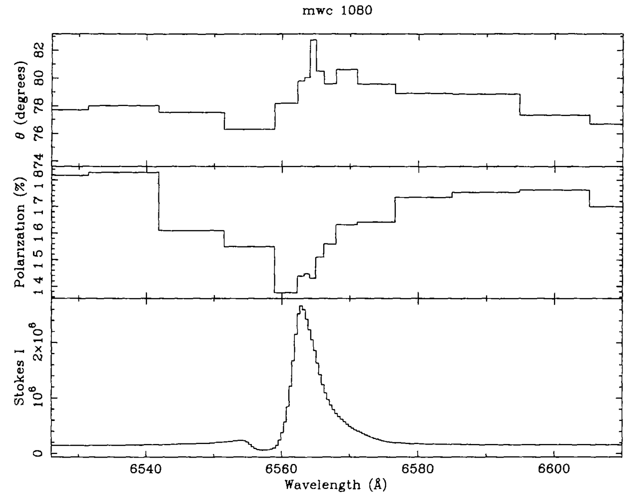

Figure 1. Polarization spectrum (middle panel) of the Herbig Be star MWC 1080 (0.07% binning). The position angle and Stokes I are also shown.

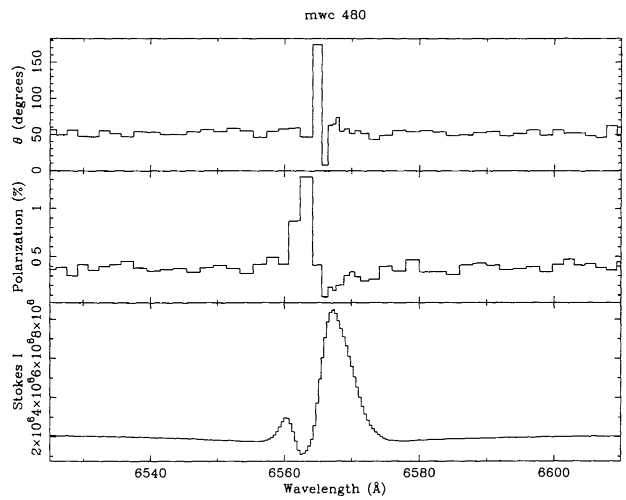

Figure 2. Polarization spectrum of the Herbig Ae star MWC 480 (0.05% binning). The panels are as in Fig. 1.

compact Hα source, located inside a rotating distribution of scatterers. Possibly, the magnetic accretor model – commonly applied to low mass T Tauri stars – is able to explain the observations for the Herbig stars at this spectral type.

To be able to make a proper distinction between inclination and intrinsic geometrical effects, we have studied a larger sample (30+) of Herbig Ae/Be stars. So far, we find: (i) For the Herbig Be stars: 10 out of 18 reveal depolarization, i.e. the classical line-effect; (ii) For the Herbig Ae stars: 9 out of 13 show an intrinsic line polarization effect.

Our data indicate that discs around Herbig Ae/Be stars are common, suggesting that the higher mass Herbig Ae/Be stars may well be disc accretors. However, the Herbig Ae and the Herbig Be stars show different polarization signatures, possibly revealing differences in their modes of accretion.