X-RAY EMISSION FROM T TAURI STARS. M. Jardine, S. G. Gregory, A. Collier Cameron, *School of Physics and Astronomy, University of St Andrews, St Andrews, KY16 9SS, UK, (mmj@st-andrews.ac.uk)*, J. -F. Donati, *Laboratoire d'Astrophysique, Observatoire Midi-Pyrénées, 14 Av. E. Belin, F-31400 Toulouse, France*.

The nature of the X-ray emission from T Tauri stars has been a puzzle for some time. The recent results from the COUP survey however show clearly that X-ray emission measures increase with stellar mass, but show a significant scatter at each mass. The presence of active accretion appears to suppress the X-ray emission somewhat.

We present a model of the coronal X-ray emission from T Tauri stars. The geometry of T Tauri coronae is determined by the structure of their magnetic fields which are as yet largely unknown. Recent observations suggest however that the surface fields are strong (with average values of around 2.5kG) and highly complex [1]. With this in mind we take as examples the magnetic fields mapped on young main-sequence stars using Zeeman-Doppler imaging [2]. We extrapolate these surface fields into the corona (Fig. 1) using the potential field source surface method used for many years to model the Sun's corona and more recently the coronae of main-sequence rapid rotators [3,4,5]. Using the masses, radii, rotation rates and coronal temperatures from the COUP database [5] we determine the emission measure of each star in the COUP sample assuming an isothermal hydrostatic corona and a disk that extends to the co-rotation radius. Along any field line where the gas pressure exceeds the magnetic pressure we assume that the field line will be blown open and the gas will escape to become part of the stellar wind. Any part of the stellar corona that extends beyond the co-rotation radius is therefore likely to be stripped away.

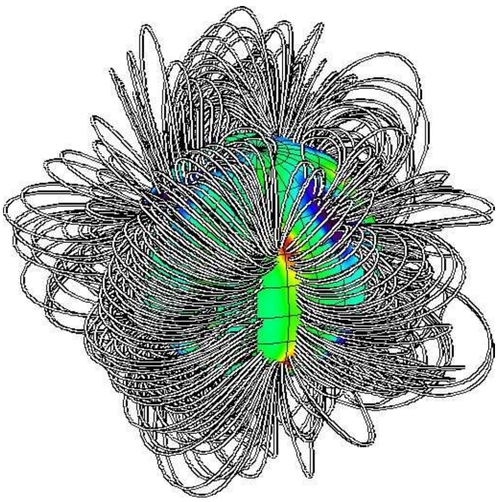

Figure 1: Coronal field structure calculated by extrapolating the surface magnetic field determined by Zeeman-Doppler imaging. The polarity of the surface field is shown in colour: blue represents -1kG and red represents 1kG. This particular example uses a surface field map of the young rapid rotator AB Dor.

We find that this simple model reproduces well both the dependence of the emission measure on stellar mass and the large scatter (Fig. 2). At each mass, the range of possible radii, rotation rates and field geometries leads naturally to a large scatter in emission measures. The rotational modulation of this emission varies with both the structure of the magnetic field and also the inclination of the stellar rotation axis. For the most compact coronae, the presence of a disk has little influence on the X-ray emission. As the extent of the corona is increased, the suppression of the X-ray emission due to the disk also increases.

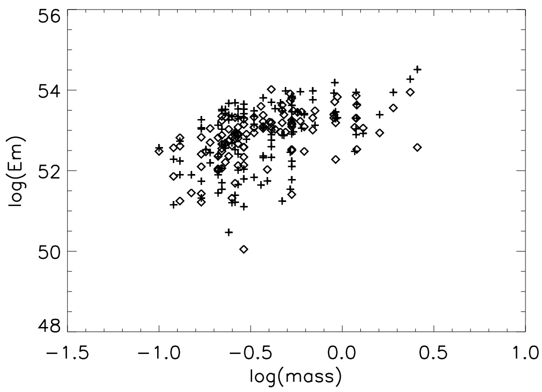

Figure 2: Emission measure (in cm^{-3}) as a function of mass (in solar masses) of those stars in the COUP sample for which masses, radii and rotation periods have been determined. The diamonds show the observed values and the crosses show the calculated values for a sample field structure where the dipolar component is strongest.

References: [1] Valenti, J.A. & Johns-Krull, C.M. (2004), Ap&SS, *292*, 619. [2] Donati, J.-F. & Collier Cameron, A. (1997), MNRAS, *291*, 1. [3] Altschuler, M.D. & Newkirk, Jr., G. (1969), Solar Physics, *9*, 131. [4] Jardine, M., Collier Cameron, A. & Donati, J.-F. (2002), MNRAS, *333*, 339. [[5] Getman, K.V., Flaccomio, E., Broos, P.S., Grosso, N., Tsujimoto, M., Townsley, L., et al. (2005, in press), astro-ph/0410136.