Magnetic coupling between cool stars and their extended atmospheres and winds

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Over the last decade, instrumental advances in high-resolution spectropolarimetry have opened up a new observational window on stellar magnetospheres. A small number of stars with high rotation rates have had their surface magnetic field distributions mapped in a manner analogous to solar magnetograms. Using both potential and non-potential field extrapolation techniques it is possible to explore the 3-dimensional structure of the closed-field part of the corona, and to estimate its extent by comparing the pressure exerted by gas at coronal temperatures in hydrostatic equilibrium with the strength of the confining field. Such models have had considerable success in modelling both the rotational X-ray light-curves of individual stars, and the statistical dependence of stellar X-ray luminosity on rotation rate and spectral type in individual clusters. At optical wavelengths, the region between the closed-field corona and the wind is seen to be populated by short-lived condensations of mainly neutral gas, dubbed "slingshot prominences". Recent observations with the VLT and AAT have provided new insights into the masses of these clouds, and into the manner of their eventual ejection into the ambient stellar wind. At the same time, a new theoretical model has provided the first convincing mechanism for the mechanical confinement of these condensations, in elongated loop-like structures protruding into the wind above large coronal arcades. Overall, a picture is emerging in which the corona-wind boundary in young, highly-active stars is a highly-structured and dynamic region.