Modelling low mass, solar-like stars with magnetic fields: impact on their fundamental properties and their circumstellar habitable zones

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A disagreement between the theoretical and observational mass-radius relations for low-mass, main sequence stars has been pointed out in many works (e.g. Spada & Demarque, 2012; see also Boyajian et al., 2012, and references therein); stellar evolution models systematically underpredict measured stellar radii by 5%–15% and overpredict observed effective temperatures at the 3%–5% level.

Although this disagreement is sometimes ascribed to non-intrinsic causes, an intriguing possibility is that the inflated radii of these stars could be a manifestation of the presence of very strong magnetic fields. These are usually neglected in "standard" stellar models, although it has been shown that their impact can be significant (Lydon & Sofia, 1995; Feiden & Chaboyer 2012).

An extension of the Yale Rotating stellar Evolution Code (YREC), capable of including magnetic fields in addition to the standard input physics, has been developed in view of the application to solar variability studies (Sofia et al., 2012). The same code can be readily applied to the study of low-mass stars, down to the M dwarfs regime.

The relevance of this for exoplanet-hosting stars is twofold. First, exoplanet characterisation relies on the precise knowledge of the fundamental parameters of the host star; secondly, a change in these parameters can affect the properties of the circumstellar habitable zone, both directly (e.g., through luminosity, effective temperature changes) and indirectly (e.g., altering the intensity and statistics of flares).

References

[1] T. Boyajian et al., ApJ **757**, 112 (2012)
[2] G. Feiden and B. Chaboyer, ApJ **761**, 30 (2012)
[3] T. Lydon and S. Sofia, ApJS **101**, 357 (1995)
[4] S. Sofia et al., ASP Conference Series **453**, 61 (2012)
[5] F. Spada and P. Demarque, MNRAS **422**, 2255 (2012)