Magneto-chronology of nearby Sun-like stars

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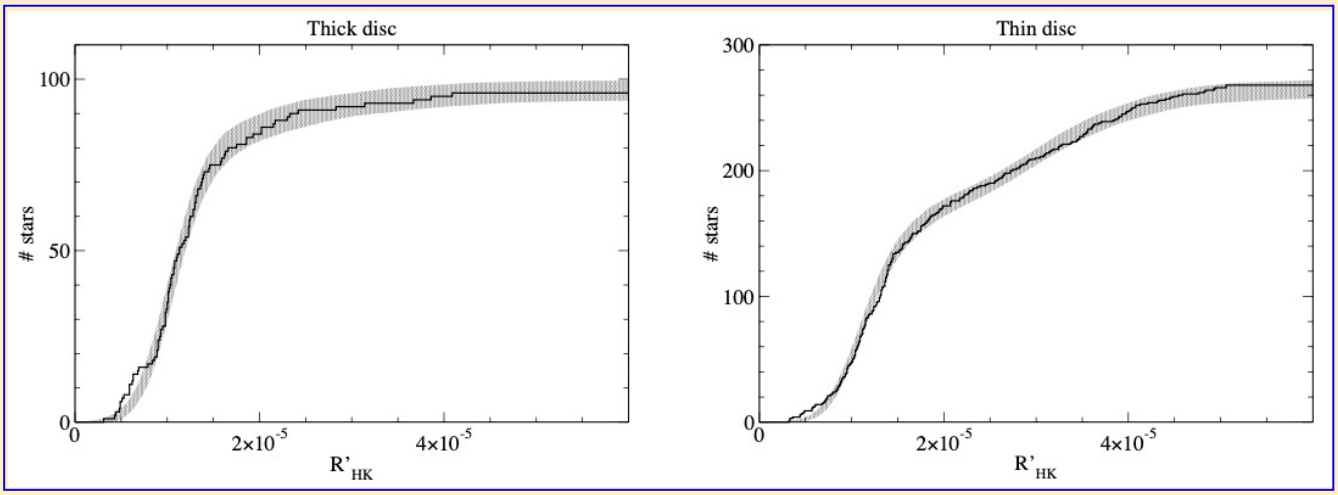
Ph. Gondoin (from A&A 641, A110 (2020))

Summary: Nearby Sun-like stars are prime targets of the PLATO mission for the detection and characterization of exo-planets and possibly exo-Earths. Understanding the formation history and determining the age of these sample stars (and their planetary systems) is thus essential.

The chromospheric emission in the cores of the Ca II H & K lines of late-type dwarfs is a well-known indicator of magnetic activity that decreases with increasing stellar age. I used this indicator to investigate the formation history of nearby G- and early K-type stars with origins at galactocentric distances similar to that of the region where the Sun was born.

A parent sample of single main-sequence stars with near-solar metallicity and known magnetic activity levels is built from catalogues of stellar atmospheric parameters and chromospheric activity indices. A kinematical approach uses *Gaia* astrometric data to differentiate thin disc stars from thick disc stars. Measured distributions of the R'_{HK} chromospheric activity indices are compared with Monte Carlo simulations based on an empirical model of chromospheric activity evolution.

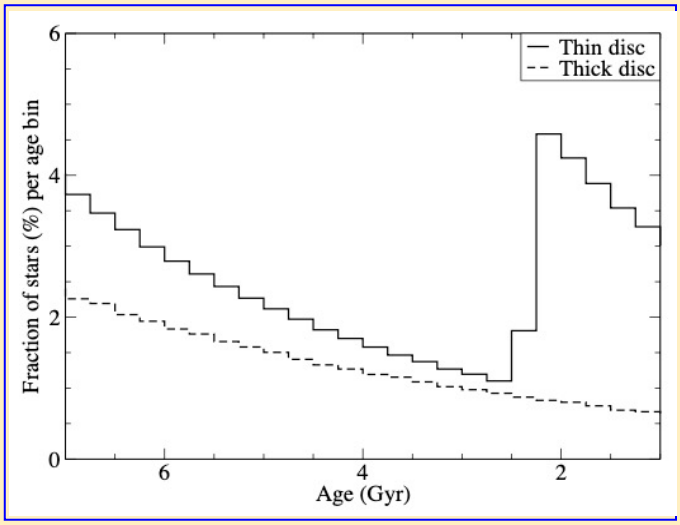
Figure 1 (below) shows the cumulative histograms of the R'_{HK} indices of the sample stars in the thick disc (left) and thin disc (right). The grey areas represent the $\pm$ 1 σ envelopes of 1000 simulated distributions of R'_{HK} index around the best fit models.



The thin disc includes a significant fraction of Sun-like stars with intermediate activity levels ($2.10^{-5} < R'_{HK} < 6.10^{-5}$), while most early K- and G-type stars from the thick disc are inactive ($R'_{HK} < 2.10^{-5}$).

The chromospheric activity distribution among nearby Sun-like dwarfs from the thin disc can be explained by a combination of an old (> 6-7 Gyr) star formation event (or events) and a more recent (< 3 Gyr) burst of star formation. Such an event is not required to account for the R'_{HK} index distributions of nearby thick disc stars.

Figure 2 (on the right side) displays the age distributions inferred from R'_{HK} index measurements of parent populations of nearby G-type and early K-type stars in the thick (dashed line) and thin (continuous line) discs of the Milky Way.



Conclusion: The distribution of magnetic activity among local G- and early K-type stars with a near-solar metallicity bears the imprint of an important star formation event that occurred ~1.9 to 2.6 Gyr ago in the thin disc of the Milky Way.