

# **Why the observed spin evolution of older-than-solar like stars might not require a dynamo mode change.**

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## **Abstract**

The spin evolution of main-sequence stars has long been of interest for basic stellar evolution, stellar ageing, stellar activity, and consequent influence on companion planets. Observations of older-than-solar late-type main-sequence stars have been interpreted to imply that a change from a dipole-dominated magnetic field to one with more prominent higher multipoles might be necessary to account for the data. The spin-down models that lead to this inference are essentially tuned to the Sun. Here, we take a different approach that considers individual stars as fixed points rather than just the Sun. We use a time-dependent theoretical model to solve for the spin evolution of low-mass main-sequence stars that includes a Parker-type wind and a time-evolving magnetic field coupled to the spin. Because the wind is exponentially sensitive to the stellar mass over radius and the coronal base temperature, the use of each observed star as a separate fixed point is more appropriate and, in turn, produces a set of solution curves that produces a solution envelope rather than a simple line. This envelope of solution curves, unlike a single line fit, is consistent with the data and does not unambiguously require a modal transition in the magnetic field to explain it.