Decoding the Evolution of Young Stars: A Look at Magnetic Fields

Max Roberts, Gregory A. Feiden
University of North Georgia

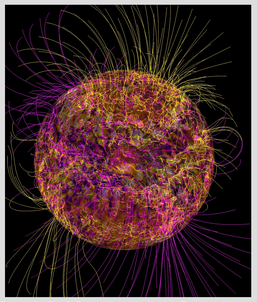
What we learned

- We confirmed a positive correlation between magnetic field strength and stellar radius.
- Models suggest that magnetically active stars may be up to a factor of two older than previously thought.

Introduction

Magnetic fields are hypothesized to increase the size of young stars. [5] Observational evidence supporting this hypothesis is scarce and based on comparisons to theoretical stellar structure models that account for magnetic fields. [2,6] However, there is no large publicly available set of these models to permit diverse and varied observational tests.

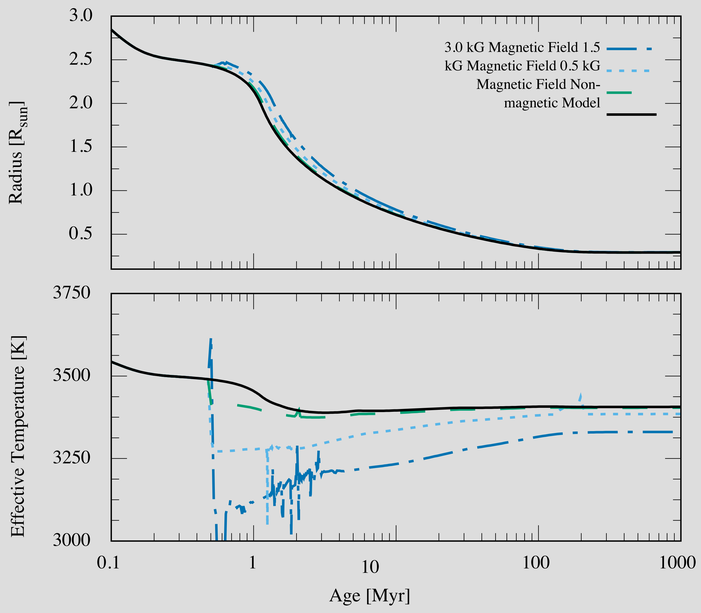
To expand on current knowledge, we present initial results from an effort to produce a grid of magnetic stellar models suitable for modeling young stellar systems of any age or metallicity.



Brun, A. S., & Bessolaz, N. (n.d.). Retrieved October 27, 2017, from http://www.stars2.eu/research_taskB2.htm

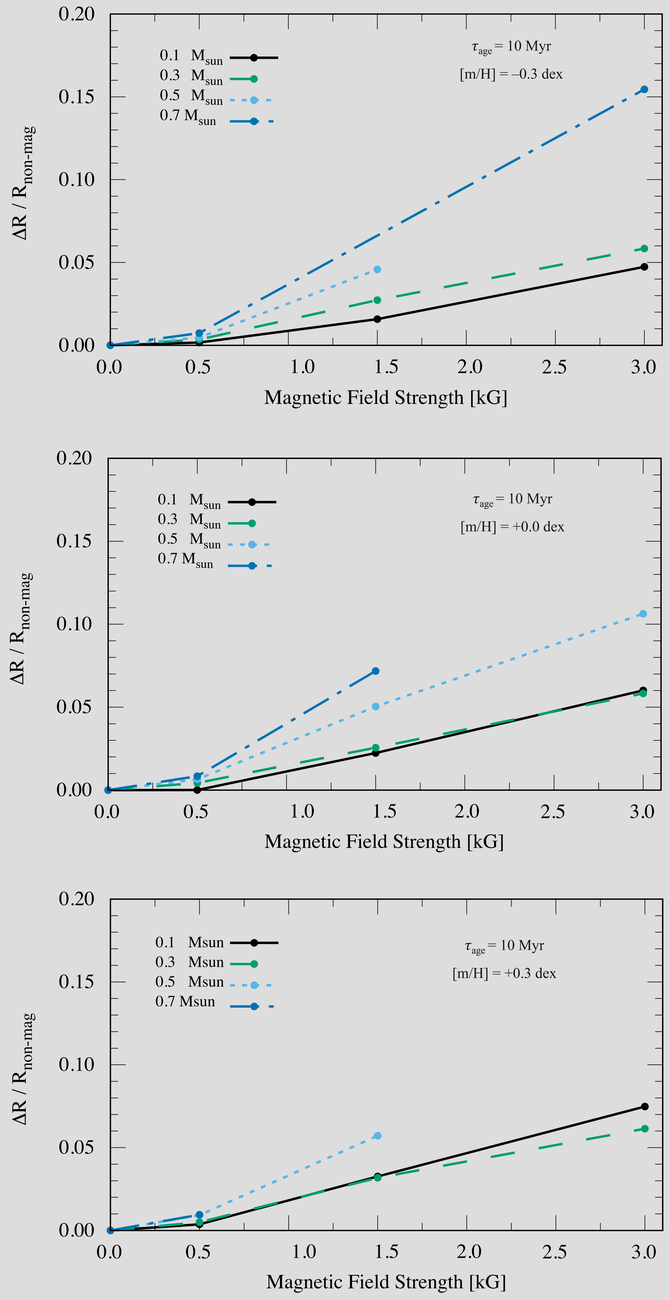
Methods and Materials

A grid of metallicities of -0.3, 0.0, and 0.3; field strengths of 500 G, 1500 G, and 3000 G; and a range of masses from 0.08msol to 0.8msol was computed using the Dartmouth Stellar Evolution Code [1], modified for use with magnetic fields [3].

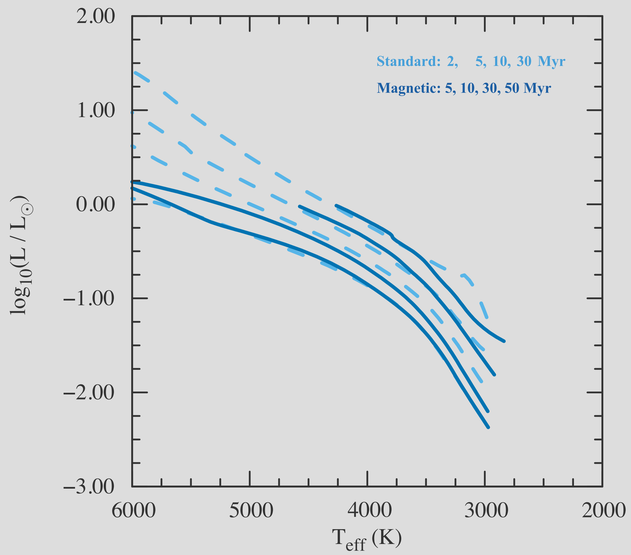


Contact:
mrrobe9557@ung.edu
gregory.feiden@ung.edu

Results



- The three figures on the left show the in index of magnetic stellar models in order of ascending metallicity. Stellar models with higher magnetic field strengths have a greater change in radius. This inflation is more drastic at higher masses, taking on an near exponential pattern. At low metallicities, low mass stars seem to be more sensitive to changes increases in magnetic field strength than at higher metallicities.
- The figure below illustrates how magnetic fields affect inferred ages of young stellar clusters. When comparing magnetic stellar models with standard models, models with magnetic fields appear to be older by approximately a factor of two.



Moving Forward

Further work must be done to increase the range of masses, metallicities, and field strengths with reliable stellar evolution models. Once completed, the model grid will permit more rigorous tests of the hypothesis that magnetic fields affect the physical properties of young stars.

References

1.Dotter et al. (2008) ApJS, 178, 89
2.Feiden (2016) A&A, 593, A99
3.Feiden & Chaboyer (2012) ApJ, 761, 30
4. Feiden & Chaboyer (2013) ApJ, 779, 183
5. MacDonald & Mullan (2010) ApJ, 723, 1599
6. Malo et al. (2014) ApJ, 792, 37