Evolution of magnetic fields in solar-type stars

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Abstract

The surface rotation rates of young solar-type stars vary rapidly with age from the end of the pre-main sequence through the early main sequence. Important changes in the dynamos operating in these stars may result from this evolution, which should be observable in their surface magnetic fields. Here we present a study aimed at observing the evolution of these magnetic fields through this critical time period. We observed stars in open clusters and stellar associations of known ages, and used Zeeman Doppler Imaging to characterize their complex magnetic fields. Presented here are results for 15 stars, from 5 associations, with ages from 20 to 250 Myr, masses from 0.7 to 1.2 times the sun, and rotation periods from 0.4 to 6 days. We find complex magnetic field geometries, with global average strengths from 14 to 140 G. There is a clear trend towards decreasing global average magnetic field strength with age, and a tight correlation between magnetic field strength and Rossby number. Comparing to younger T Tauri stars, we find a strong change in magnetic properties as stars begin to develop radiative cores. The results reported here provide new constraints on rotational evolution models of solar-type stars.

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