Testing Gyrochronology with Kepler: Stellar Period-Age Relations for Realistic Populations

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Abstract

The technique of gyrochronology uses the observed relationship between rotation period, stellar color, and age to date old field stars based on two key assumptions: 1) that all targets can be treated as single main sequence stars that spin down as a function of time, and 2) that the relations can be calibrated on systems of solar age and younger and extrapolated to old stars, where data has traditionally been sparse. With Kepler we have the opportunity to test both assumptions. Spot modulation periods for several thousand stars and asteroseismic ages for several hundred make it possible to examine gyrochronology in the hitherto untested old field star populations. We show that stellar samples that include both subgiants and stars above 6250 K fail to reproduce the literature gyrochronology relationships, and highlight the importance of contaminating stellar populations (hot stars, evolved stars, blends, and binaries) in the interpretation of stellar rotation periods. However, we also find that sample composed only of of MS dwarfs follows the expected empirical relationship between period and age. We examine the importance of metallicity in this period-age relationship, and critically evaluate the performance of gyrochronology extrapolations against the actual behavior of stars at late times.

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