Rotation, differential rotation, and stellar ages using Kepler

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Abstract

With CoRoT and Kepler a new era of high-precision photometry has begun. These measurements provide surface rotation periods for tens of thousands of stars, unprecedented in their number and accuracy. Both telescopes provide the opportunity to study surface differential rotation (DR), which induces additional periods in the light curve, making it obsolete to speak of "the" stellar rotation period.
Using only Kepler Q3 data we showed that a second period adjacent to the most significant period was quite common (75%), and we associated this period to surface differential rotation (Reinhold et al. 2013). Considering all Kepler quarters, we show here that spot evolution, either due to migration or growth/decay, and the interplay with DR, strongly affects the period detection, thus hampering reliable measurements of the surface shear.
Moreover, precise rotation periods (and color information) are urgently needed to estimate stellar ages via gyrochronology. DR induces an uncertainty of the (most significant) rotation period, which increases the already large error bars of stellar ages.
We present rotation periods, differential rotation measurements, and age estimates using gyrochronology relations for thousands of stars. We compare "gyro-ages" to those derived by stellar modeling and other methods. Furthermore, we present the detection a subset of very stable periods, which could either be a hint for surface features induced by tidal locking of non-eclipsing binaries, or be due to pulsations.

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