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Title: Internal Stellar Rotation Detected by Kepler and Its Implications
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Abstract: Rotation can have important implications for the structure and evolution of stars. It is also related to the star and planet formation process and can serve as a potent diagnostic of stellar properties. However, our understanding of the physics of angular momentum evolution, especially for internal angular momentum transport, has been limited. We can now measure the core rotation of evolved subgiants and giants using Kepler asteroseismology, and this data poses severe challenges for existing theoretical models. After an overview of the main observational results, I focus on the theoretical interpretation. Differential rotation is much stronger in low mass first ascent giants than it is in massive core He-burning stars; this provides evidence that convective cores are efficient agents for angular momentum transport in stars. The solar rotation profile is not universal, but the evolved star data is consistent with solar-like profiles in their main sequence precursors and decoupling setting in during the first dredge-up phase. The strengths and weaknesses of the main agents for internal transport (hydrodynamic, wave-driven, and magnetic) are discussed; both purely hydrodynamic and strong magnetic coupling models are not consistent with the empirical data. The broader astrophysical implications of these results are also addressed, and key observational tests will be highlighted.

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