A Stellar Perspective on the Magnetic Future of the Sun

Travis Metcalfe (SSI)
Rotation and activity decay together

Skumanich (1972)
Revised evolution beyond middle age

Evidence of unexpected behavior:
1. Rotation vs. Age
2. Rotation vs. $T_{\text{eff}}$ (proxy for Mass)
3. Activity level vs. Rotation
4. Cycle period vs. Rotation
1. Old stars rotate faster than expected
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van Saders et al. (2016, Nature)
2. Slow rotators absent or undetected

McQuillan et al. (2014); van Saders et al. (2018)
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McQuillan et al. (2014); van Saders et al. (2018)
3. Chromospheric activity plunges

Metcalfe, Egeland & van Saders (2016)
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Metcalfe, Egeland & van Saders (2016)
4. Activity cycles get longer, disappear

Böhm-Vitense (2007); Metcalfe & van Saders (2017)
4. Activity cycles get longer, disappear

Böhm-Vitense (2007); Metcalfe & van Saders (2017)
Spindown mostly from largest scales

Reville et al. (2015); see also Garraffo et al. (2015)
α-effect weakens at low field strength

Brandenburg, Mathur & Metcalfe (2017)
$\Omega$-effect less efficient as rotation slows

Petit et al. (2008)
Dynamo eventually shuts down

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Kitchatinov & Nepomnyashchikh (2017)
Future observational tests

• Constraints on solar angular momentum loss from *in situ* data and magnetic field geometry
• Measurements of stellar differential rotation below a critical activity level (log R'\(\text{h}k < -5\))
• Zeeman Doppler Imaging observations of stars to determine large-scale magnetic field topology
• Asteroseismology with the TESS mission to determine precise masses and ages for Mount Wilson stars with known activity cycles
• Ground-based chromospheric activity monitoring for Kepler targets spanning the transition