The potential for observing stellar activity cycles with SONG

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Solar cycle in context

Böhm-Vitense (2007)
Solar cycle in context

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Calcium H&K emission

Photosphere

Chromosphere

Proxy for the strength and filling-factor of magnetic field
Mount Wilson S-index

\[ S = \alpha \frac{H + K}{R + V} \]
Sun-as-a-star observations

- Use disk-integrated time series measurements to track solar activity cycle
- Photometric variations generally from medium-band Strömgren b and y
- Amplitude of variations two orders of magnitude smaller in photometry

Lockwood et al. (2007)

- Started by O. Wilson in 1968 using the 2.5-m for a sample of 91 stars
- Increased cadence in the 1980's using the 1.5-m for hundreds of stars
- The survey stopped in 2003, after nearly 35 years of observations

Baliunas et al. (1995)
Rotation and latitudinal shear

- Observations with daily cadence started in 1980's to measure rotation rates

- Different rotation periods in different seasons as active latitudes migrated

- Larger range of observed periods for cooler stars, traces latitudinal shear

- 1.1-m telescope close to Flagstaff Arizona, allocate 7 nights/month bright time

- Solar observations 3-6x per week, 50 target stars sampled a few nights/mo.

- Solar/stellar/comparison all fed to spectrograph through the same fiber
Evolution of activity cycles

Egeland et al. (2017)
SMARTS survey (2007-2013)

• Small telescopes at CTIO now run by a consortium; HAO was a minor partner

• Monitor bright southern asteroseismic targets for stellar activity variations

• Queue-scheduling avoids large seasonal data gaps, reveals shorter cycles

LCOGT survey (2017-2020+)

- Network of Robotic Echelle Spectographs (NRES) on LCOGT
- Asteroseismic targets from Kepler that span a range of activity levels
- Mount Wilson stars with < 22-day rotation periods should have short cycles
Opportunities for discovery

Metcalfe & van Saders (2017)
BlueSpec: off-the-shelf spectrograph

Master Student
Nicholas E. Jannsen

with: C. Karoff, S. Holmbo, J. Jessen-Hansen

theta Cyg in 300 sec

Ca II doublet

H K
SONG survey?

• Commercial fiber-fed spectrograph mounted at the Nasmyth focus

• Daily cadence during asteroseismic runs at beginning/end of night

• Monthly cadence for activity cycles in larger sample of targets