The Variability of Sun-like Stars
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Lake Arrowhead, CA
“...It remains to be shown whether the emission lines of the star have a possible variation in intensity analogous to the sun-spot period.”

1 - Context

The Mount Wilson Observatory (MWO) HK Project, 1966-2003

I. INTRODUCTION

This work was undertaken to answer the general question, Does the chromospheric activity of main-sequence stars vary with time, and if so, how? The most accessible indices of chromospheric activity in these stars are the emission components centered in the broad, deep H and K absorption lines of Ca II.

1 - Context

The Mount Wilson Observatory (MWO) HK Project, 1966-2003

1 - Context

The Solar-Stellar Spectrograph (SSS) HK Project, 1992-2018+
1 - Context

The Lowell-Fairborn Photometry Program, 1984-2018+
1 - Context
The SSS Team Today

HALL
LOCKWOOD,
SKIFF
BRIGHT
BAYER
EGELAND
METCALFE
HENRY
BOYD
RADICK
PEVTSOV
2 – MWO and SSS Data: The Good, the Bad, and the Ugly

\[ S = \alpha \frac{H + K}{R + V} \]
2 – MWO and SSS Data: The Good, the Bad, and the Ugly

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3 – Recent Progress and Conclusions

3A – Patterns of Stellar Variations
3B – Activity Cycles in the SSS Data
3C – The Nature of Flat Activity States in Solar Analog Stars
3D – Searching for Stellar Maunder Minima
3A – Patterns of Stellar Variations
Patterns of Variation for the Sun and Sunlike Stars

HD 146233 (18 Sco)

HD 30495

3B – Activity Cycles in the SSS Data

- **146233/G2V**: 14 + 6.5
- **13974/G0V**: 6.5 + 2.4
- **97334/G1V**: Irr
- **22049/K2V**: 3.0
3B – Activity Cycles in the SSS Data

- **HD 22049/K2V 3.0**
  - 1970–2018
  - Activity cycles observed

- **HD 190406/G0 V 14.5 + 2.5**
  - 1970–2018
  - Activity cycles observed
3B – Activity Cycles in the SSS Data

92 densely sampled stars
35 cycling, 6 irregular, 30 flat, 7 long, 2 hybrid...and 12 to go!
3C – The Nature of Flat Activity States in Solar Analog Stars

Baliunas & Jastrow 1990

Hall & Lockwood 2004
3C – The Nature of Flat Activity States in Solar Analog Stars
3D – Searching for Stellar Maunder Minima

Giampapa et al. 2006
3D – Searching for Stellar Maunder Minima

140538/G0V

140538  492 obs  $<\log R'>$ = -4.78  $<S>$ = 0.213
4 – After 52 Years, Now What?

1. An SSS + MWO Database for the Community

2. Observations of ~35 solar analogs + a “snapshot” survey

3. Design and development of follow-on program
4 – After 52 Years, Now What?
Thank you, SORCE!