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Maunder Minimum stars revisited: recalibrating Ca II H & K measures

Jason T. Wright
Department of Astronomy, University of California, Berkeley, CA 94720, USA
email: jtwright@astro.berkeley.edu

Abstract. We discuss a recalibration of Ca II H & K measures in sun-like stars.

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Baliunas & Jastrow (1990) analyzed the distribution of activity among apparent solar analogs (selected by $B-V$ color) in the Mount Wilson H & K survey (Baliunas *et al.* 1995) and found a population of stars with activity levels significantly below that of the Sun at solar minimum. They suggested that these stars reside in a state analogous to the Maunder Minimum (Eddy 1976) and that their fraction of the sample was representative of the time Sun-like stars spend in such a state.

Wright (2004) (W04 hereafter) used *Hipparcos* parallaxes to show that this population of apparently very inactive stars is composed almost entirely of subgiants or slightly evolved dwarfs, and found an activity floor as a decreasing function of $\Delta M_{\rm V}$, the height a star above the main sequence. Wright (2004) argued that this effect is due to the inadequate calibration of the Mt. Wilson S-index of Noyes *et al.* (1984), which neglects the effects of gravity and metallicity on the photospheric flux in the H and K line cores.

Errors in estimates of the photospheric component of the H and K flux are only important for old, inactive stars such as the Sun, where the photospheric contribution can comparable to the chromospheric contribution. Its improper subtraction causes photospheric contamination in chromospheric flux measurements, making chromospheric ages beyond ~ 2 Gyr unreliable.

Analysis of the abundances and gravities in the SPOCS catalog Valenti & Fischer (2005) confirms the suspicions of Wright (2004) that not only evolved stars but metal-rich stars also show a significantly lower activity 'floor' than do solar analogs, consistent with their height above the main sequence. In fact, the activity floor is a surprisingly clean function of $T_{\rm eff}$ and $\Delta M_{\rm V}$ independent *reason* a star sits above the main sequence – metallicity or evolution. Recalibrating the S-index (and the related $R'_{\rm HK}$ index) for the effects of metallicity and gravity will first require measurement of the photospheric contribution to S as a function of those quantities using high-resolution spectra. Further correction for the effects of metallicity on line blanketing in the continuum in the color-correction factor will require flux-calibrated spectra of the continuum near the H and K lines for stars spanning a range of [Fe/H], $\log g$, and $T_{\rm eff}$ values. These efforts will be the subject of a forthcoming work.

References

Baliunas, S. L., Donahue, R. A., Soon, W. H., *et al.* 1995, *ApJ*, 438, 269
Baliunas, S., & Jastrow, R. 1990, *Nature*, 348, 520
Eddy, J. A. 1976, *Science*, 192, 1189
Noyes, R. W., Hartmann, L. W., Baliunas, S. L., *et al.* 1984, *ApJ*, 279, 763
Valenti, J. A., & Fischer, D. A., *ApJS*, 159, 141
Wright, J. T. 2004, *AJ*, 128, 1273