Variations in Solar Line Bisectors Over a Full Activity Cycle

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Detection of Earth-mass rocky exoplanets using the radial velocity (RV) technique must deal with intrinsic variations in apparent stellar RVs due to magnetic suppression of photospheric convection. While it is clear that magnetic signatures can be distinguished from center-of-mass RV shifts in absorption lines, it is less clear that those effects can be separated cleanly when both are present. We advocate transforming spectral line bisectors so that activity and center-of-mass effects become statistically independent in the product of the analysis. To that end, we have investigated variations in line bisectors of the Sun-as-a-star, observed by the SOLIS project (Synoptic Optical Long-term Investigation of the Sun) operated by the National Solar Observatory. The SOLIS data cover a full solar cycle (since 2006), in contrast to the more recent data using HARPS and other high precision spectrometers. Preliminary results from our SOLIS analysis indicate that activity effects over Cycle 21 can be cleanly separated from the center-of-mass RV, at a level sufficient to detect Earth-mass planets. However, the Sun-as-a-star is a favorable case, because (among other reasons) the solar spectrum does not shift strongly in wavelength with respect to microtelluric lines. Consequently, we are also investigating the utility of line bisectors for real RV observations of stars obtained from the orbiting Earth.