Frequency Comb Calibrated Laser Heterodyne Radiometry for Doppler Spectroscopy and Activity Measurements of the Sun

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High-precision and high-resolution studies of line shapes and positions are critical for tackling the problem of RV variability due to stellar activity. By mixing sunlight with a single-frequency laser on a fast photodetector, laser heterodyne radiometry (LHR) enables high-resolution spectroscopy (R~1 million) in a compact apparatus that only consists of a few single-mode fiber and radio frequency components. By simultaneously measuring the single-frequency laser against a laser frequency comb, we have achieved high-resolution, high-precision LHR spectroscopy with long-term absolute frequency stability. Accounting for optical loss, bandwidth, and averaging time our measured signal-to-noise ratio matches the limit given by quantum optics. In a 10 min measurement of a solar iron line we have demonstrated an SNR of over 2000 and a centroiding precision below 1 MHz, only 1 part in 4000 of the linewidth. This presentation will focus on the instrument design, characterization, and tests/evaluation of systematics to support sub m/s radial velocity precision with LHR on single-line measurements in the 1.5um region of the solar spectrum.