Decomposing stellar variability: A spectral atlas of the spatially resolved Sun

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Extreme precision radial velocity measurements require excellent reference observations. One of the fundamental obstacles in reaching sub-m/s radial velocity (RV) precision is the temporal and centre-to-limb variation of spectral lines. The Sun is the perfect benchmark for these kinds of high spectral resolution observations.
We obtain observations of the spatially resolved Sun at the Institute for Astrophysics and Geophysics in Göttingen and observe the spatially resolved solar surface (Ø 32 arcsec) with a high-resolution Fourier Transform Spectrograph (R~700,000, lambda 420-800 nm). Our solar atlas includes 14 heliocentric positions (mu = 0.2 – 1.0).
This talk will give an overview of our analysis of the centre-to-limb variations of the Sun. We analyse the limb-dependent convective blueshift as a function of line formation temperature for more than 400 spectral lines and compare our results to simulations. Our data quantitatively shows the impact of convection on disc-integrated line profiles. Furthermore, our spectra enable the comparison of convective velocities, gravitational redshift and the accuracy of laboratory wavelengths. Such high-fidelity solar observations reveal the limits in precision and accuracy for solar RV jitter and zero-point definition.