Long-Term Brightness Variability of Sun-like Stars

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Observations of Sun-like stars revealed stellar brightness variability on multiple time-scales, where variations on the time-scales of rotational periods and of magnetic activity cycles are induced by stellar magnetic features. Similar brightness changes occur on our Sun, where they can be observed in detail and have been extensively studied. Thus, models for solar irradiance variations have been developed for decades and provide accurate agreement with the solar observations. Since stellar variability is based on the same concepts that were used in solar irradiance models, those can be extended to investigate Sun-like stars. In our approach we focus on stars with the same surface distribution of magnetic features as the solar case, but different fundamental stellar parameters, e.g. metallicities and effective temperatures. Our investigation reveals that for such stars the amplitude of the brightness variations has a local minimum in the neighborhood of solar metallicity and effective temperature. This is because brightness variability is caused by a delicate balance between dark and bright magnetic features, which is sensitive to the combination of stellar fundamental parameters. Moreover, we show that even a small change (e.g. within observational error range) of metallicity significantly increases the photometric variability. This allows to explain a long-standing puzzle: The observation that solar brightness variability on the time-scale of the 11-year activity cycle is anomalously low in comparison to variability of Sun-like stars with near-solar level of magnetic activity.