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The detection and characterization of faculae- vs spot-dominated stars

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The rotation period is in general easy to detect in regular and well-modulated light curves of young and active stars. However, despite the success of the Kepler and TESS missions, reliable information on rotation periods for Sun-like stars is still lacking (as in about 75% of stars in the Kepler field). Stars with solar-analog variability exhibit non-periodic light curves, low variability contrast, short lifetime evolution, and random emergence of magnetic features. In this work, we show that the profile of the gradient of the power spectra (GPS) can be used to determine rotation periods even for stars with complex brightness variations, like the Sun. By characterizing the shape generated by facular or spot transits from models, as well as, recorded in the total solar irradiance, we quantified whether the stellar surface was dominated by facular or spot regions. We found that Sun-like stars are distributed between three different regimes, spot-dominated, faculae-dominated, and stars in a transition between the two. Moreover, we performed a spectroscopic and polarimetric analysis of the stellar activity for a sample of twin stars and compared these results with the photometric characterization. Our findings shed light on the question of what makes a star's surface preferentially facula- or spot-dominated. This analysis will provide valuable insights for characterizing the rotation, surface features, and activity of stars observed by future missions like PLATO.

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