N07a Universal Atmospheric Heating Mechanisms of the Sun and Sun-like Stars

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Understanding the mechanisms responsible for heating the chromospheres and coronae of the Sun and late-type stars is one of the most fundamental problems in solar and stellar physics. Although it is thought that the magnetic field plays a key role in driving and transporting the energy from the stellar surface upwards, the current observations are unable to spatially resolve stellar atmospheres to investigate if magnetically driven heating is at work on the stars. Here, we present the results of the solar and stellar data analysis providing critical clues to the common nature of the heating mechanisms of coronae, transition regions, and chromospheres of the Sun and sun-like stars. We systematically studied the variations of total unsigned magnetic flux and spectral irradiances of X-ray, ultraviolet, optical and radio bands of the Sun from May 2010 to February 2020, i.e., spanning almost one solar activity cycle. We found that the variation amplitudes of solar irradiance and magnetic flux show power-law relations with an exponent decreasing from $\sim$1.3 to $\sim$0.8 as the temperature decreases from a few million K in the corona to 10,000 K in the chromosphere. We also complemented the solar data with the available stellar data in the literature, mainly of the G-type dwarfs with ages spanning from 50 Myr to 4.5 Gyr, and compared the solar trends with the stellar data. As a result, we found that the stellar data points are located on the extensions of the power-law relations derived from the solar data. This suggests that the atmospheric responses to the underlying magnetic flux are universal for the Sun and sun-like stars, regardless of age or activity.