M07a Magnetic flux-line iraddiance scaling laws for the Sun and Sun-like stars

Shin Toriumi (JAXA), Vladimir S. Airapetian (NASA, American Univ.), Kosuke Namekata (NAOJ), Yuta Notsu (CU Boulder, NSO, Tokyo Tech.)

Late-type dwarf stars including our Sun commonly exhibit magnetic activity in a variety of forms. The magnetic flux on the surface transports the energy upwards and heats the outer atmospheres, the chromosphere, the transition region, and the corona, although the exact mechanism is still remains unclear. In Toriumi & Airapetian (2022), by comparing the power-law scalings between the total magnetic flux and the spectral line irradiances at various wavelengths (from the chromosphere to the corona) for both the Sun and Sun-like stars, we found that the solar-type stars share a common atmospheric heating mechanism regardless of their age or activity level. In this study, we increase the number of the spectral lines by a factor of two, especially for the transition region, to investigate the change in heating efficiency from the chromosphere to the corona. The result shows that the power-law exponent, which links the surface magnetic flux and the spectral line irradiances, of the transition region is comparable to that of the chromosphere ($\alpha < 1$). This implies that the heating mechanisms of these layers are close, but an explanation for the $\alpha < 1$ tendency is currently lacking and awaits theoretical clarification. In addition, we derive the scalings of the line irradiances with not only the total magnetic flux but also other proxies such as the total sunspot number, the sunspot area, and the F10.7 radio flux. This makes it possible to reproduce the line irradiances of the Sun and Sun-like stars from these, more readily available, longer-term measured, or more easily estimatable, proxies.