

Starspot mapping and multiwavelength variability for a young solar-type star

*Kai Ikuta¹, Kosuke Namekata^{2,3,4,5}, Hiroyuki Maehara⁵, Vladimir Airapetian^{3,4}, Pascal Petit⁶, Yuta Notsu^{7,8}, Daisaku Nogami², Kazunari Shibata^{2,9}, EK Dra collaboration

1. The University of Tokyo, 2. Kyoto University, 3. National Aeronautics and Space Administration (NASA), 4. American University, 5. National Astronomical Observatory of Japan (NAOJ), 6. Université de Toulouse, 7. University of Colorado Boulder, 8. National Solar Observatory, 9. Doshisha University

Recent simultaneous multiwavelength observations by the Transiting Exoplanet Survey Satellite (TESS), Seimei telescope, and Neutron star Interior Composition Explorer (NICER), have provided evidence for stellar prominence eruptions associated with superflares on a young solar-type star EK Draconis (EK Dra) (Namekata et al. 2024a). Such superflares are suggested to have been caused by large spots on the polarity inversion line near the stellar limb from the concurrent result of the Zeeman Doppler Imaging (ZDI) at the Bernard Lyot telescope (Namekata et al. 2024b). Thus, to investigate the relation between spot locations from the optical photometry and occurrence of superflares, we perform starspot mapping for the TESS light curve of EK Dra with the code (Ikuta et al. 2020). We also analyze the rotational variability of the TESS light curve, H α spectrum by the Seimei/KOOLS-IFU, and X-ray data by the NICER, each of which corresponds to the stellar photosphere, chromosphere, and stellar atmosphere (corona), respectively. As a result, we find that (i) some spots are deduced to be near the limb when superflares occurred, (ii) spot locations are consistent with those obtained from the ZDI except for a polar spot, and (iii) the H α spectrum produced around spots exhibits clear periodicity with respect to the TESS light curve. However, the X-ray data does not show such strong association probably because of multiple spots on the surface and the extended spatial structure of coronal active regions (Ikuta et al., to be submitted). This study enables us to explore the relation between stellar magnetic fields and the stellar atmosphere toward quantifying the stellar XUV radiation to the planetary atmosphere.

Keywords: solar-type star, starspot, stellar magnetic field, stellar atmosphere, stellar flare, G-dwarf