N02a Multi-Temperature Mass Ejections from Stellar Flares on a Young Solar Analogue

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Solar flares are often accompanied by coronal mass ejections (CMEs), which can affect planetary environments in the modern Solar System. Similarly, CMEs from the early Sun may have significantly influenced the formation and evolution of planetary atmospheres in the early Solar System. Young solar-analog stars with frequent flaring activity are considered to offer proxies for the radiation/plasma environment of the early Sun. However, the overall physics of associated CMEs remains poorly understood due to the lack of multi-wavelength observations.

Through March 29 to April 1, 2024, we performed multi-wavelength observations of a young solar analog, EK Draconis (50-120 Myr-age G1.5V ZAMS, R=0.94$R_\odot$, M=0.95$M_\odot$, $P_{\rm rot}$=2.7 d), with FUV spectroscopy with HST and optical spectroscopy in Japan/Korea. We detected the first multi-wavelength signatures closely related to stellar CMEs via Doppler shifts in FUV lines and optical Hα line. An impulsive FUV flare with an energy of $\sim10^{32}$ erg shows blueshifted emission components in warm FUV lines, such as C III and Si IV ($\sim10^5$ K), during the pre-flare and impulsive phases, reaching velocities of 300–550 km s^{-1}. Comparison with solar observations suggests that these warm blueshifts could trace CMEs. 10 min later, the Hα line exhibits a slow (–70 km s^{-1}) and long-lasting ($\gtrsim$2 hrs) blueshifted absorption, suggesting a cool eruption ($\sim10^4$ K). In this talk, we will discuss the relationship between the nearly-simultaneous, multi-temperature CME signatures.