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Detection of filament eruption on Sun-like star

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Stellar flares are the sudden brightening on the stellar surfaces where the magnetic energy is released via the magnetic reconnection [1, 2]. Some Sun-like stars are known to have much higher magnetic activity than the Sun, and sometimes show very large flares called 'superflares' (flare having the energy of more than 10 times the largest solar flare energy) [3]. Recently, there is an increasing interest in the properties of stellar flares both from the perspective of their impact on the exoplanet environment and from the viewpoint of a possible extreme space weather event on our Sun. So far, the stellar (super-)flare properties have been well investigated with optical photometry [2, 3]. However, multi-wavelength observations have not been enough conducted, especially for superflares on Sun-like stars, because of the low occurrence probability and the difficulty of simultaneous observations, and therefore the detailed nature of radiation/heating mechanism of stellar (super-)flares has not been understood.

Solar filament is a cool (~10,000 K) plasma in the solar atmosphere. Filament eruptions often occur associated with solar flares, sometimes affecting the Earth's environment. On the other hand, the filament eruption has not been reported on stars other than the Sun. Here we report a discovery of a gigantic and fast stellar filament eruption on an active young Sun-like star through optical spectroscopic observations with the Japanese 3.8-m Seimei telescope (Namekata et al. 2022, Nature Astronomy [4]; Figure 1 left). The temporal changes in the hydrogen spectra of the stellar filament eruption greatly resemble those of solar filament eruptions, indicating a common MHD process of solar and stellar filament eruptions. The erupted mass of stellar filament is an order of magnitude larger than the maximum solar mass ejection. Our discovery reveals a picture that gigantic filament eruptions could affect the environment of exoplanets and contribute to stellar mass/angular-momentum evolution (Fig. 1 right).

We are now investigating statistical properties of superflares on Sun-like stars, and we will review the on-going project in our telescope.

References

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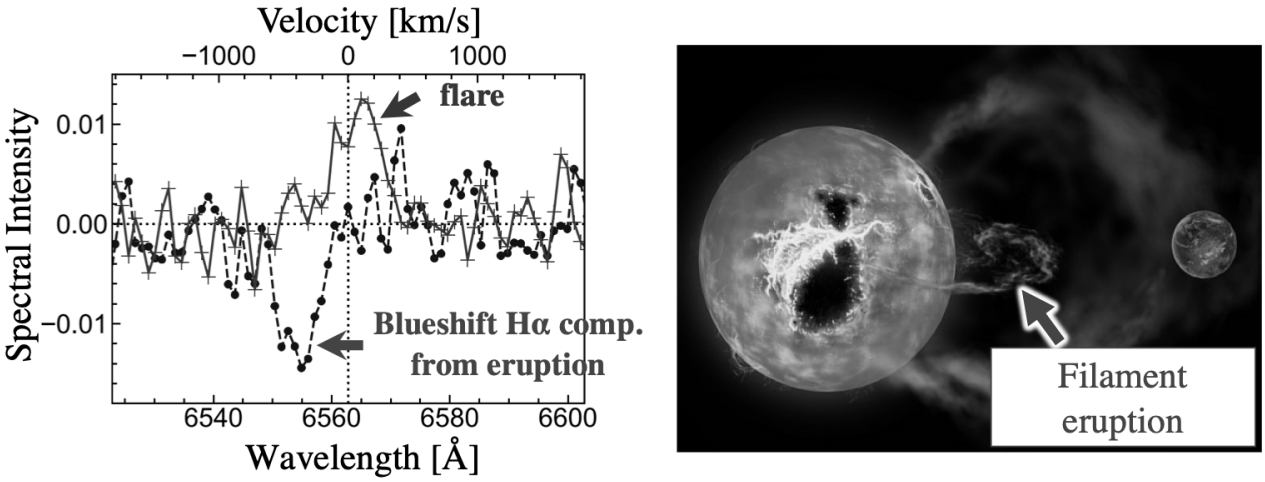

Fig 1. (Left) An observational evidence of a stellar filament eruption seen in the hydrogen H-alpha spectrum. (Right) A schematic picture of a gigantic filament eruption on stars.