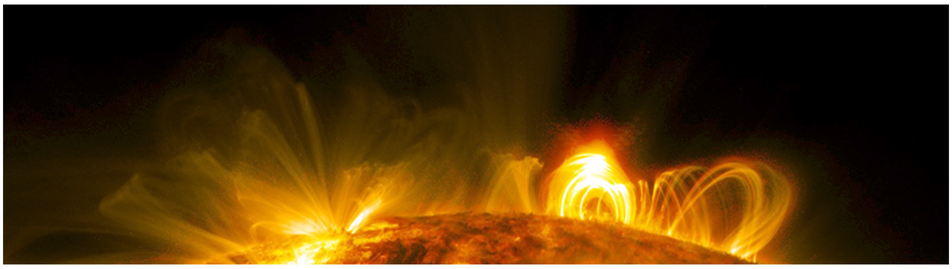

Contribution ID: **54** Type: **Poster**

Multiple wavelengths observation of large stellar flares on the active RS CVn-type star UX Ari with MAXI, NICER, Ibaraki-Yamaguchi radio interferometer, and CAT

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The study of stellar flares has been greatly advanced by MAXI (Monitor of All-sky X-ray Image), which started its operation in 2009. MAXI observes a large area of the sky once per 92-minute orbital cycle and makes it possible to search for stellar flares effectively. All these flares are found to be at the upper ends for stellar flares with the total energy of 10^{34-39} erg (e.g, Tsuboi et al. 2016). However, the geometry, state of stellar surfaces, and the decay process of these giant flares are not known in detail as opposed to the Sun because stars cannot be image-resolved. Therefore, it is important to analyze the differences in the light curves at multiple wavelengths, the state of the plasma, and the time evolution of the elemental abundances to provide observational constraints on the understanding of the stellar flare picture. We have conducted multi-wavelength observations of the RS CVn-type star UX Ari for about two months using MAXI, NICER (Neutron star Interior Composition Explorer; 0.2–12 keV), Ibaraki-Yamaguchi radio interferometer (6.7 GHz, 8.3 GHz), and CAT (Chuo-university Astronomical Telescope; V-band). As a result, two flares are detected in total in the X-ray and the radio bands. The first flare has a total energy of ~10^{37} erg in the 2-10 keV band, and the second one, of which the peak has not been detected, has ~10^{37} erg at least in the same band. This means the flares are both 10^5 times or larger than the largest solar flares. The flares had the long e-folding times of ~20 days in the radio band, and where along with the rotational modulation with the same period as the spin period of the binary system. Such phenomena have been reported in huge flares (Elias et al. 1995), though such long decay time can never be explained by just one impulsive supply for the accelerated electrons, as discussed in Catalano et al. (2003). On the other hand, the X-ray flux shows no obvious sinusoidal variation in these flares. The NICER spectra in the 0.3-8 keV are well reproduced by an absorbed two-temperature optically thin thermal plasma model when we set the elemental abundances of O, Ne, Si, S, and Fe to be free. The time variation of the abundance indicates that the high-FIP elements (< 10 eV) are more enhanced as compared to the low-FIP elements throughout our observation period, having the "FIP bias" of -0.8 ~ -0.5; i.e. inverse FIP effect. The negative values (inverse FIP effect) are consistent with the flares on other, magnetically active stars. The noteworthy thing in our observation is that the FIP bias shows sinusoidal variation, anti-correlating with the variation in the radio flux. This indicates that the radio-loud region is compact and is essential to the inverse FIP effect.

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