Astronomy & Astrophysics Division Seminar

Title : X-ray Superflares on Solar-type Stars

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Date : 03.05.2018 (Thursday)

Time : 16:00 Hrs

Venue : Seminar Room # 113/114 (Thaltej Campus)

Abstract: Flares on the Sun and the stars are generally interpreted as a rapid and transient release of magnetic energy in coronal layers driven by reconnection processes, associated with electromagnetic radiation from radio waves to γ-rays. The typical total energy of a solar flare ranges from 10^29 to 10^32 erg, whereas Superflares are defined as the flares with the total energies of 10^33–10^38 erg. Although there are few hundreds of Superflares have been already discovered in optical waveband, the discoveries of X-ray superflares are still rare events (only nine have been discovered). The study of superflares on solar-type stars provides us important constraints of the upper end of the dynamical behavior of stellar corona as well as it helps us to probe the possibility of superflares on the Sun. In this seminar, I will talk about the analysis of three X-ray superflares. The first two superflares occurred on a fast-rotating (period of 1.56 day) main-sequence star CC Eri, and the third one occurred on an evolved 3.966-day period RS CVn type eclipsing binary system SZ Psc. In case of the superflares from CC Eri, it has been found that the flares decay faster in the hard X-ray band than in the soft X-ray band. Both flares are highly energetic with respective peak X-ray luminosities of ∼10^{32.2} and ∼ 10^{31.8} erg s^{−1} in 0.3-50 keV energy band. The time-resolved spectral analysis during the flares shows the variation in the coronal temperature,

emission measure, and abundances. The observed peak temperatures in these two flares are found to be 174 and 128 MK. Using the hydrodynamic loop modeling, we derive loop lengths for both the flares as 1.2+/-0.1 x 10^{10} cm and 2.2+/-0.6x10^{10} cm, respectively. The Fe Kα emission at 6.4 keV is also detected in the X-ray spectra and we model the Kα emission feature as fluorescence from the hot flare source irradiating the photospheric iron. These superflares are the brightest, hottest, and shortest in duration observed thus far on CC Eri. On the other hand, the superflare on SZ Psc lasted very long duration for more than 100 ks, which is the longest duration X-ray flare ever observed as the best of our knowledge. Spectral analysis indicates a presence of one temperature corona, which represents the flare temperature. The temperature is one of the highest observed spectroscopically with a peak at 258 MK, which is ∼10 times more than the observed minimum value. The length of the flaring plasma was derived to be 7.3 x 10^{11} cm. The longer coronal loop and high level of magnetic activity at the coronal height for the RS CVn type binary star is probably due to the presence of extended convection zone of the sub-giant and the high orbital velocity.
