

EUV and X-Ray Solar Flares Observed on-board the “Coronas-F” Satellite

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1. EUV instrumentation and measurements onboard CORONAS-F

The CORONAS-F satellite has been launched on 31 July 2001 (Oraevsky *et al.* 2002). To conduct measurements of the intensity of solar radiation in the EUV spectral region near the hydrogen line L_{α} ($\lambda = 121.6$ nm) the spectrophotometer VUSS was installed onboard CORONAS-F. A vacuum photodiode was used as EUV detector in VUSS with the CuJ cathode and MgF_2 entrance window.

During a period of solar activity maximum a lot of flares were observed. The first observational results on EUV fluxes during these flares and their comparison with GOES 0.1-0.8 nm fluxes are presented below. As an example let us first consider the Solar flare of X5.3 class (the optical class 3B), which took place on August 25, 2001, and was one of the most intensive flares registered by VUSS instrument. Fig.1 gives the VUSS measurements of this flare in the L_{α} line.

The figure also presents the temporal X-ray changes within the 0.1-0.8 nm wave-range observed on - board the GOES-8 satellite. On Fig.1 a dip in the line corresponds to an entry of the satellite into a zone of twilight. A break was caused by a loss of information between communication sessions. It is evident that moments of maximum fluxes differ: an X-ray achieves maximum ~ 13 minutes later than EUV-emission. A scale of variations is also different: EUV emission changes by $\sim 2.7\%$, while X-ray emission changes by the dozens of times. It is also important that duration of the flare in EUV region (about several seconds) is considerably shorter than in X-ray region. These characteristics are typical of the most flares observed.

A maximum of the most flares observed in EUV region occurs before an appearance of an X-ray maximum; EUV-emission leads X-ray emission by 2-13 minutes. Figure 2a presents a dependence of time difference δT (minutes) between flare maxima observed in EUV and X-ray regions, on emission intensity in 0.1-0.8 nm wave-range (GOES-8).

Fig. 2a shows that δT is increasing with an increase of a flare power. The tendency is evident though a spread in data is rather great.

One of the main characteristics is a power emitted in the maximum of a flare. Figure 2b presents data on an energy of the flares in L_{α} depending on the 0.1-0.8 nm X-ray energy during a flare maximum. An unperturbed value of intensity in L_{α} line was taken from the paper (Nusinov 2004). On Fig.2b one can see relation between amplitudes of Solar flares in X-ray (0.1-0.8 nm) and EUV (~ 120 nm) ranges. The points observed are well approximated by a straight line (it is shown on the Fig.2b), i.e. there is a power law dependence between flare fluxes within the range of two orders of magnitude of X-ray changes. The same relation was obtained earlier by Kazachevskaya *et al.* 1996 and was also found for soft X-rays by Nusinov & Chulankin 1997.

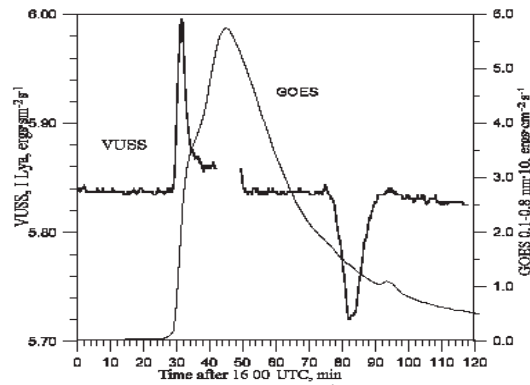


Figure 1. The flare of August 25, 2001: changes of VUSS and GOES(0.1–0.8 nm)

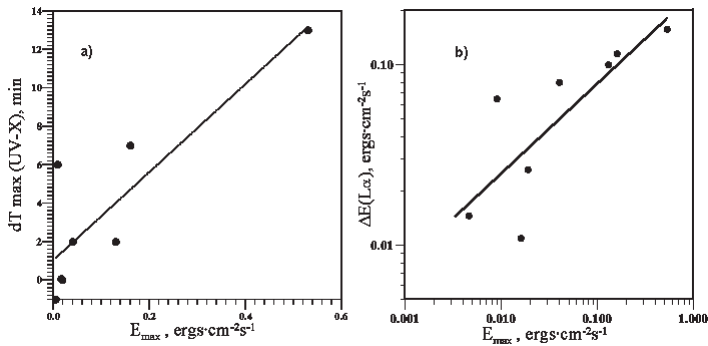


Figure 2. Dependence of *a.* time delay and *b.* EUV energy on X-ray flare energy.

2. Conclusion

1. Relative values of flares amplitudes in the band of $\sim 120\text{nm}$ were found. It was confirmed that during even the most intensive flares an increase of emission in this band did not exceed several percents.

2. There is a power law correlation between soft X-ray and EUV emission. It allows to estimate EUV flux changes in the periods of flares on the basis of the X-ray patrol data.

3. Study of the EUV Solar flux variations in different wave-ranges revealed that at the beginning of a flare and during its maximum phase EUV emission systematically led soft X-ray emission by 2–5 minutes. To all appearance there is a possibility that a flare development takes place not in the corona's loops but in the upper layers of the Solar atmosphere.

Acknowledgements

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