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 $L_\alpha (\lambda = 121.6$ 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 $L_\alpha$ 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 $\sim 13$ 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 $\delta T$(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 $\delta T$ 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 $L_\alpha$ depending on the 0.1-0.8 nm X-ray energy during a flare maximum. An unperturbed value of intensity in $L_\alpha$ 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 ($\sim 120$ 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.
2. Conclusion

1. Relative values of flares amplitudes in the band of $\sim 120$ 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.

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References


