FEATURES OF A SOLAR FLARE EXCESS IN MAY–JUNE 2024

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Strong X-ray class X flares are relatively rare events on the Sun. The 25th cycle of solar activity differs significantly from the previous cycle in many respects, in particular, in the productivity of X-flares. Thus, during the first 4.5 years of cycle 25, 54 events of this class were registered. This is more than for 11 years in the 24th cycle (49 X-flares).

In May–June 2024, a largely unexpected flare excess was observed, when between May 3 and June 10, 4 active regions (ARs) produced 25 X-class flares. In the entire history of X-ray observations, such excesses have not been observed. Thus, in AR13663 5 X-events were registered among 80 flares of all classes, in AR13664 (with the record square area in cycle 25) — 13 out of 101, in AR13685 — 1 out of 19, in AR13697 — 6 out of 119. The situation where four Class X outbreaks occurred on May 8/9 within the same 24-hour period has no precedent. The total energy of flares in these 4 ARs, released over 39 days, amounted to 17% of the total flare energy released on the Sun over 4.5 years in the X-ray range.

All noted flare ARs were located in the cores of activity complexes (ACs), which are usually the main localization sites for strong flares, as shown in [Isaeva et al., 2019]. However, AC membership alone cannot explain such a significant kurtosis. Short time intervals between successive flares in the same AR (sometimes up to 8–12 hours) indicate the action of some physical mechanism that ensures a regular “refueling” of the AR with magnetic energy, and not just large reserves of initially stored energy. It can be assumed that in this case a deep “channel” was operating through which new portions of the magnetic flux emerged from the depth of the convective zone. As a result, 19 X-flares were observed in AR13644 and in AR 13697, which formed in its place, not counting those that probably occurred here while on the far side of the Sun.

AR 486, which produced 8 X-flares in October–November 2003, can be considered an incomplete analog of AR 13664 [https://www.spaceweatherlive.com/].

The work was carried out at the Astrophysical Complex of MSU-ISU, supported by the Ministry of Science and Higher Education of Russia (agreements EB-075-15-2021-675, 13.UNU.21.0007, state assignment FZZE-2020-0017, FZZE-2020-0024).

REFERENCES

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