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Superflares on Solar-Type Stars

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Stellar flares emit harmful UV and high-energy particles such as protons. Although the atmosphere protects the surface of the planets, certain amount of UV penetrates the atmosphere and high-energy particles reach the ground as secondary radiation. These radiations are thought to affect habitability and evolution of life.

High precision photometry of Kepler spacecraft enables us to detect superflares on G-type dwarfs. By extending Maehara et al. (2012, Nature), we found 1547 superflares on 279 G-type dwarfs detected from light curves of 500 days (Shibayama et al., 2013, ApJS). In the case of the Sun-like stars (with surface temperature 5600 - 6000 K and slowly rotating with a period longer than 10 days), the frequency of superflares with energy of 10^{34} - 10^{35} erg (100 - 1,000 times larger than the largest solar flare) is once in 800 - 5000 years. No hot Jupiters were found in these superflare stars. These superflare stars often show quasi-periodic brightness variation, which might be evidence of the large star spot. Rotational period can be estimated from the brightness variation period. It is interesting that superflares are detected on slowly rotating stars (P $>$10 days) like the Sun. Using these data, we studied the statistical properties of superflares. We compare the flare frequency distribution of the superflare and solar flare, and study the similarity of them. We also found that some G-type dwarfs show very high activity and exhibit superflares once in ~ 10 days. In the case of Sun-like stars, the most active stars show one superflare in ~ 100 days.

Keywords: Stellar flare, Solar flare, Habitability, Evolution