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Statistical properties of superflares on solar-type stars

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Solar-flares are energetic explosions in the solar atmosphere. The energy released by a solar flare is typically of the order of 10^{29} - 10^{32} erg. Recent high-precision photometry from space shows that ”superflares”, which are 10-10000 times more energetic

than the largest solar-flares, occur on Sun-like stars (slowly rotating G-type main sequence stars).

We present recent results on superflares on solar-type stars using the high time-resolution data. We search for superflares from the short-cadence data (time resolution: 1 min) of about 1300 solar-type stars observed with the Kepler space telescope and found about 150 superflares on 20 stars. The energy of detected flares ranges from 10^{33} to 10^{35} erg, which is equivalent to that of X100 - X10000 class solar flares. These superflare data, combined with the previous results from the low time-resolution data (1547 superflares on 279 solar-type stars), indicate that the occurrence frequency distribution of superflares can be fitted in the energy range $>10^{33}$ erg by a simple power-law function with the index of about -2. Moreover, the frequency distribution of superflares on Sun-like stars and that of solar flares are roughly on the same power-law line. The average occurrence frequency of superflares with energy of 10^{33} erg (X100 class) is about once in 100 years and that of superflares with energy of 10^{34} erg (X1000 class) is about once in 1000 years. The duration of superflares depends on the total energy released by superflares. Larger flares tend to have longer duration time. The duration of superflares is proportional to the 1/3 power of the flare energy. This correlation between energy and duration of superflares on solar-type stars is similar to that of solar flares. These results suggest that statistical properties of superflares on solar-type stars is basically the same as thoes of solar flares.

Keywords: superflare, solar flare