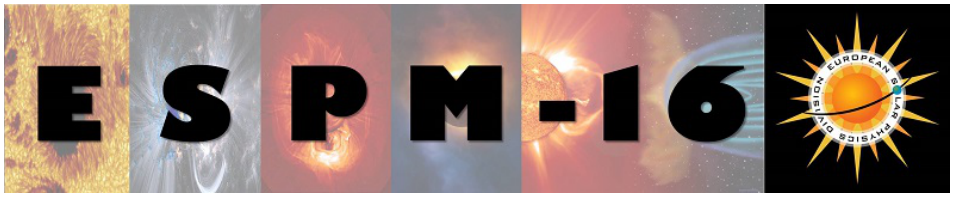

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Nanoflare distributions over solar cycle 23 based on AIA/SDO DEM analysis

Tuesday 7 September 2021 10:18 (13 minutes)

We study the energy distributions of nanoflares in quiet Sun regions, using Differential Emission Measure (DEM) analysis of observations from the 6 EUV filters of the Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamics Observatory (SDO). In total, we analyzed 30 sets of AIA/SDO image series distributed evenly between the years 2011 and 2018 to characterize the nanoflare frequency distribution and their contribution to coronal heating throughout different levels of solar activity during solar cycle 23. Each series covers a $400'' \times 400''$ field-of-view close to disc center over an observation time of two hours at the full AIA cadence of 12 seconds. DEM analysis was used to derive the emission measure and temperature evolution for each pixel. The nanoflare frequency distribution was then extracted from the DEM results for each data set by a threshold-based algorithm developed for the AIA data characteristics.
We find that the combined nanoflare frequencies follow a power-law distribution with a power-law index $\alpha = 2.3$ that covers five orders of magnitude in event energies (10^{23} to 10^{28} erg). The power-law index obtained from individual data sets shows only minimal variation over the multi-year period and no significant correlation to solar activity. The steep slope ($\alpha > 2$) suggests that the dominant energy contribution resides in the small flare events (nanoflares). However, we find that the combined energy flux from all the detected events is at least an order of magnitude too small to account for the heating requirement of the solar corona.

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