Title:
Bounded Power-law Characterizations of Solar Flares

Joshua Ingram
New College of Florida, Center for Astrophysics | Harvard & Smithsonian

Lucas Guliano
Center for Astrophysics | Harvard & Smithsonian

Vinay Kashyap
Center for Astrophysics | Harvard & Smithsonian

Eun-jin Kim
Coventry University

Xiao-li Meng
Harvard University, Statistics

Xufei Wang
Harvard University, Statistics

Abstract:
Distributions of solar flare properties have previously been observed to follow a power-law over a wide range of values within a bounded region. However, these distributions tend to turn over due to detection sensitivity limitations at low flare energies and small samples at high flare energies, resulting in an unclear region in which the power-laws occur. To address this semi-parametric problem, we utilize the maximum product of spacings method on the GOES database, covering cycles 23 and 24, to simultaneously estimate the left and right ends of the power-law regions, normalization constants, and exponents of the power-laws. We perform a Monte Carlo analysis to find the error bars of the estimates and report results for several properties including total energy, peak flux, wait time, quiet time, and duration for the respective aggregate, by-solar cycle, and by-year distributions. For the first time, the exponents are estimated self-consistently over regions that are statistically demonstrated to follow a power-law. We confirm that the exponent for the total energy power-law is similar to previous estimates and find that the power-law steepens, as expected, for wait and quiet times as it gets closer to the solar maxima.
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