First NuSTAR Limits on Quiet Sun Hard X-Ray Transient Events

We present the first results of a search for transient hard X-ray (HXR) emission in the quiet solar corona with the Nuclear Spectroscopic Telescope Array (NuSTAR) satellite. While NuSTAR was designed as an astrophysics mission, it can observe the Sun above 2 keV with unprecedented sensitivity due to its pioneering use of focusing optics. NuSTAR first observed quiet-Sun regions on 2014 November 1, although out-of-view active regions contributed a notable amount of background in the form of single-bounce (unfocused) X-rays. We conducted a search for quiet-Sun transient brightenings on timescales of 100 s and set upper limits on emission in two energy bands. We set 2.5–4 keV limits on brightenings with timescales of 100 s, expressed as the temperature T and emission measure EM of a thermal plasma. We also set 10–20 keV limits on brightenings with timescales of 30, 60, and 100 s, expressed as model-independent photon fluxes. The limits in both bands are well below previous HXR microflare detections, though not low enough to detect events of equivalent T and EM as quiet-Sun brightenings seen in soft X-ray observations. We expect future observations during solar minimum to increase the NuSTAR sensitivity by over two orders of magnitude due to higher instrument livetime and reduced solar background.

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