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Estimation of the global occurrence rate of elves with Mini-EUSO

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Elves are the most common type of transient luminous events, with estimates of their global occurrence rate ranging from a few to a few tens per minute. Here, we present the first derivation of the global occurrence rate of elves from Mini-EUSO observations. Mini-EUSO is a wide field of view, space-based telescope operating from a nadir-facing UV-transparent window in the Russian Zvezda module on the International Space Station. It observes the Earth's atmosphere in the UV band with a spatial resolution of about 6.3 km and a temporal resolution of 2.5 μ s. Its optical system made of two 25 cm diameter Fresnel lenses focuses the light into a square array of 48x48 pixels, each pixel being capable of single photon counting. Originally designed to detect the faint fluorescence light produced by extensive air showers induced by extreme energy cosmic rays, it was shown to be capable of detecting a wide range of atmospheric phenomena, including elves. Elves are dynamically traced by Mini-EUSO in their horizontally expanding, fast donut-shaped light emissions and can therefore be unequivocally identified. Mini-EUSO can usually detect elves whose center is just outside the field of view, following the expansion of the ring for hundreds of microseconds. Combining the number of detected elves with consideration of the time and geometries, it is possible to derive a first estimate of their global occurrence rate with Mini-EUSO, and to compare it to the literature.