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Discovery of the Sub-second Linearly Polarized Spikes of Synchrotron Origin in the UV Ceti Giant Optical Flare

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Abstract

Copyright © Astronomical Society of Australia 2017During our optical monitoring of UV Ceti, iconic late-type flaring star, with high temporal resolution using the Russian 6-m telescope in 2008, we detected a giant flare with the amplitude of about 3 magnitudes in U band. Near flare maximum, more than a dozen of spike bursts have been discovered with triangular shapes and durations from 0.6 to 1.2 s and maximal luminosities in the range (1.5–8) × 1027 erg s−1. For the half of these events, the linear polarization exceeds 35% with significance better than 5σ. We argue that these events are synchrotron emission of electron streams with the energies of several hundred MeV moving in the magnetic field of about 1.4 kG. Emission from such ultra-relativistic (with energies far exceeding 10 MeV) particles is being routinely observed in solar flares, but has never been detected from UV Ceti-type stars. This is the first ever detection of linearly polarized optical light from the UV Ceti-type stars which indicates that at least some fraction of the flaring events on these stars is powered by a non-thermal synchrotron emission mechanism.

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Keywords

polarization – radiation mechanisms: non-thermal – stars: flare – stars: individual (UV Ceti)