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An Enigmatic PeVatron in an Area around HII Region G35.6–0.5

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It is difficult to identify hadronic PeVatrons (the PeV particle accelerator) from the ultra-high-energy (UHE, $E > 100$ TeV) gamma-ray sources, which is however crucial in revealing the origin of cosmic rays. As an endeavor in this regard, we focus in this work on the UHE gamma-ray source 1LHAASO J1857+0203u, which may be associated with supernova remnant (SNR) G35.6–0.4 and H II region G35.6–0.5. We analyze the LHAASO WCDA and KM2A data, and report the point-like nature with a significance of 10.1σ above 100 TeV. While in the energy range of 1–30 TeV, it shows an extension of $r_{39} = 0.18^\circ$. The spectra measured by WCDA and KM2A can be smoothly connected, with power-law spectral indexes of ~ 2.5 and ~ 3.2 , respectively. Given the low mass of the environmental molecular clouds, it is unlikely that the TeV gamma-ray emissions arise from the clouds illuminated by the protons escaped from SNR G35.6–0.4. In the scenario that HII region G35.6–0.5 can accelerate particles to the UHE band, the observed GeV–TeV gamma-ray emission could be well explained by a hadronic model with a power-law spectral index of ~ 2.0 and a cutoff energy of ~ 260 TeV. However, a pulsar-wind-nebula origin cannot be ruled out.

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