

Multimessenger study of neutrino-candidate blazar PKS 0735+178 using Korean VLBI Network multi-band observations

The discovery of high-energy TeV/PeV neutrinos (HENs) by the IceCube Neutrino Observatory has motivated extensive efforts to identify their astrophysical origins. Blazars, a subclass of active galactic nuclei with relativistic jets aimed toward Earth, have emerged as promising HEN candidates, especially after the association of a HEN event with the blazar TXS 0506+056. However, the origin of HENs remains largely uncertain and requires further dedicated multi-wavelength correlation and spectral analyses. In early December 2021, IceCube and other observatories reported HEN events spatially coincident with this source. Notably, the blazar exhibited multi-wavelength flares from radio to gamma-rays, nearly concurrent with the HEN events. In this study, we explore a potential connection between HENs and radio flares from the relativistic jet of the blazar PKS 0735+178. To investigate this apparent correlation, we conducted very long baseline interferometry (VLBI) follow-up observations using the Korean VLBI Network (KVN) at 22, 43, 86, and 129 GHz from December 2021 to November 2023. Our VLBI imaging reveals a compact milli-arcsecond-scale jet and increasing radio flux density following the HEN events. Spectral analysis of synchrotron self-absorption shows a rising peak flux density over time, while the turnover frequency and spectral index remained stable. This implies shock formation in the jet, potentially linked to HEN production. We further confirmed this spectral evolution through a complementary analysis using Gaussian multi-frequency VLBI analyses (GaMVAs), based on the multi-frequency synthesis technique.

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