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Polarization flare of 3C 454.3 in millimeter wavelengths seen from decadal polarimetric monitoring data sets

Content

A blazar 3C 454.3 ($z = 0.859$) has been extensively investigated in multi-wavelength high-resolution polarization studies, showing polarization variations in milli-arcsecond (mas) scale. We aim to investigate polarimetric characteristics on the blazar 3C 454.3 at 22-129 GHz using decadal (2011-2022) data sets. In addition, we also aim to delve into the origin of the polarization flare in 2019. The corresponding data sets were obtained from the monitoring programs of the Korean VLBI Network (KVN) single-dish and of the 43-GHz Very Long Baseline Array (VLBA). Using those data, we compared the consistency of the measurements between scales at mas and arcsecond. We also estimated the Faraday rotation measure (RM) by fitting a linear function and computing it at each of the adjacent frequency pairs. Relations between polarimetric measurements indicate a preferred polarization angle when the source is highly polarized. By comparing scales between mas and arcsecond at 43 GHz, we find consistency in polarized emission (flux density and polarization angle), indicating negligible convolution effect on polarization angle by the extended jet of 3C 454.3. While the linear fit yields an order of RM $\sim 10^3$ rad m^{-2}, |RM| from each frequency pair tends to be larger at higher frequency pair, indicating varying RM as a function of frequency. We found an interesting, notable flaring event in polarized emission in 2019 at the frequency range of 22-129 GHz from the KVN single-dish data. During the flare, the observed polarization angles rotate from $\sim 150^\circ$ to $\sim 100^\circ$ at all frequencies with chromatic m_p. We suggest the polarization flare in 2019 is attributed to the shock-shock interaction in Region C based on the observed m_p and χ_obs, and also the Faraday rotation measure. Change in the viewing angle of the jet lacks in explaining the increased brightness temperature, indicating an additional particle acceleration in Region C.

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