The Core-like Nature of HST-1 in the M87 Jet

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We investigate the total flux density, spectral, polarization, and Faraday rotation variability of HST-1 in the M87 jet during the outburst from 2003 to 2007 through multi-epoch VLA observations at 8, 15, and 22 GHz. Contrary to the general case for blazars, the flux densities of HST-1 rise earlier at lower frequencies from radio to X-ray, and the spectra are softening with the growth of outburst, indicating that the newly emerging subcomponents within HST-1 have relatively steep spectra. In particular, the intrinsic EVPA varies monotonically by $\sim90^\circ$ at the 3 wavebands during the period, and all but the stationary subcomponent in the eastern end of HST-1 move downstream superluminally deviating divergently from the overall jet direction, with the motion of the outmost subcomponent bending from one side of the jet axis to another. These strongly argue for the presence of helical magnetic fields around HST-1, which is also supported by the fact that the subcomponents might be accelerated in this region. The fractional polarization is relatively low in the rising stage, and in the decaying stage the polarization levels are almost comparable at the 3 wavebands. In view of the quite large RM values, Faraday rotation is expected to occur dominantly external to HST-1 in the decaying stage, which is well supported by the presence of diffuse emission around HST-1, and consistent with the scenario that RM decrease gets slower with time.

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