

The complex variability of blazars: Time-scales and periodicity analysis in S4 0954+65

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Abstract

Among active galactic nuclei, blazars show extreme variability properties. We here investigate the case of the BL Lac object S4 0954+65 with data acquired in 2019-2020 by the Transiting Exoplanet Survey Satellite (TESS) and by the Whole Earth Blazar Telescope (WEBT) Collaboration. The 2-min cadence optical light curves provided by TESS during three observing sectors of nearly 1 month each allow us to study the fast variability in great detail. We identify several characteristic short-term time-scales, ranging from a few hours to a few days. However, these are not persistent, as they differ in the various TESS sectors. The long-term photometric and polarimetric optical and radio monitoring undertaken by the WEBT brings significant additional information, revealing that (i) in the optical, long-term flux changes are almost achromatic, while the short-term ones are strongly chromatic; (ii) the radio flux variations at 37 GHz follow those in the optical with a delay of about 3 weeks; (iii) the range of variation of the polarization degree and angle is much larger in the optical than in the radio band, but the mean polarization angles are similar; (iv) the optical long-term variability is characterized by a quasi-periodicity of about 1 month. We explain the source behaviour in terms of a rotating inhomogeneous helical jet, whose pitch angle can change in time.

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Keywords

BL Lacertae objects: general, BL Lacertae objects: individual: S4 0954+65, Galaxies: active, Galaxies: jets

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