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A Multiwavelength Study of the Most Distant Gamma-ray Detected BL Lacertae Object 4FGL J1219.0+3653 (z=3.59)

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Abstract

BL Lac objects are a class of jetted active galactic nuclei that do not exhibit or have weak emission lines in their optical spectra. Recently, the first γ-ray emitting BL Lac beyond z=3, 4FGL J1219.0 +3653 (hereafter J1219), was identified, i.e., within the first two billion years of the age of the universe. Here we report the results obtained from a detailed broadband study of this peculiar source by analyzing the new γ58 ksec XMM-Newton and archival observations and reproducing the multiwavelength spectral energy distribution with the conventional one-zone leptonic radiative model. The XMM-Newton~data revealed that J1219 is a faint X-ray emitter (F0.3–10 keV=8.39+4.11−2.40×10−15 erg/cm2/s) and exhibits a soft spectrum (0.3–10 keV photon index=2.28+0.58−0.48). By comparing the broadband physical properties of J1219 with z>3 γ-ray detected flat spectrum radio quasars (FSRQs), we have found that it has a relatively low jet power and, similar to FSRQs, the jet power is larger than the accretion disk luminosity. We conclude that deeper multiwavelength observations will be needed to fully explore the physical properties of this unique high-redshift BL Lac object.

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