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An interpretation involving ALPs in the TeV spectrum of GRB 221009A

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The extraordinary gamma-ray burst (GRB) 221009A, identified as the brightest GRB ever recorded, exhibited remarkable high-energy emissions as observed by the Large High Altitude Air Shower Observatory (LHAASO). We demonstrate that synchrotron self-Compton (SSC) emission from shock-accelerated electrons during the afterglow phase can account for the observed spectral energy distribution (SED) of GRB 221009A in the GeV–TeV range. However, the portion of the SED above 8 TeV is difficult to interpret due to severe attenuation by extragalactic background light (EBL). To address this issue, we consider the role of axion-like particles (ALPs), which can convert into photons and vice versa in the presence of magnetic fields during propagation. We apply the Markov Chain Monte Carlo (MCMC) method to fit the observed spectrum using the SSC model while accounting for EBL absorption. For photons above 8 TeV, we employ the CLs method to explore exclusion regions in the ALP parameter space by comparison with the EBL absorption model. Our results show that ALP-photon conversion can effectively explain the observed TeV spectrum, particularly above 8 TeV, and suggest that GRB 221009A can provide competitive constraints on ALP parameters space.

Collaboration you are representing

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