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Possible origins of > 10 TeV photons detected from the burst of all time (BOAT) GRB 221009A

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Gamma-Ray Burst (GRB) 221009A was once in a century event detected from radio to very high-energy (VHE) gamma rays. It was the first time that > 10 TeV gamma rays were detected from a GRB. Even though GRB 221009A was a relatively nearby event at redshift 0.15, detection of a 18 TeV photon by the LHAASO detector and of a 251 TeV photon by the Carpet-2 detector challenge conventional radiation mechanisms of a GRB and/or propagation of VHE gamma rays in the cosmic radiation backgrounds. In particular, gamma-ray flux at 18 TeV is expected to be attenuated by a factor $\sim 4.5 \times 10^{-5}$ and more severely at 251 TeV due to $\gamma\gamma \rightarrow e^{\pm}$ pair production by interacting with the photons of the extragalactic background light (EBL). In this presentation, I will discuss possible explanation of the detection of 18 TeV photon due to ultrahigh-energy cosmic rays originating from GRB 221009A and interacting while propagating along the line-of-sight [1], and the detection of 251 TeV photon due to violation of Lorentz invariance [2].

[1] S. Das and S. Razzaque, "Ultrahigh-energy cosmic-ray signature in GRB 221009A," *Astron. Astrophys.* **670**, L12 (2023) [arXiv:2210.13349 [astro-ph.HE]].

[2] J. D. Finke and S. Razzaque, "Possible Evidence for Lorentz Invariance Violation in Gamma-Ray Burst 221009A," *Astrophys. J. Lett.* **942**, no.1, L21 (2023) [arXiv:2210.11261 [astro-ph.HE]].

Apply to be considered for a student ; award (Yes / No)?

No

Level for award;(Hons, MSc, PhD, N/A)?

N/A

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