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Hadronic origin TeV afterglow from GRB 221009A

Gamma-ray burst (GRB), GRB 221009A, a long-duration GRB, was observed simultaneously by the Water Cherenkov Detector Array (WCDA) and the Kilometer Squared Array (KM2A) of the Large High Altitude Air Shower Observatory (LHAASO) during the prompt emission and the afterglow periods. Characteristic multi-TeV photons up to 13 TeV were observed in the afterglow phase. The observed very high-energy (VHE) gamma-ray spectra by WCDA and KM2A during different time intervals and in different energy ranges can be explained very well in the context of the photohadronic model with the inclusion of extragalactic background light models. In the photohadronic scenario, interaction of high-energy protons with the synchrotron self-Compton (SSC) photons in the forward shock region of the jet is assumed to be the source of these VHE photons. The observed VHE spectra from the afterglow of GRB 221009A are similar to the VHE gamma-ray spectra observed from the temporary extreme high-energy peaked BL Lac (EHBL), 1ES 2344+514 only during the August 11 and the August 12 of 2016 and are new, first among their kinds in the GRB context. In future, from the observations of many more GRBs in VHE at low redshifts, we expect to identify some of them with a two-zone VHE emission, features similar to the ones observed in the several nearby transient EHBL-like sources.

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