Contribution ID: **556** Type: **Talk in the parallel session**

X-ray Plateaus in Gamma-Ray Burst Afterglows and Their Application in Cosmology

Wednesday, 7 July 2021 08:45 (15 minutes)

For gamma-ray bursts (GRBs) with a plateau phase in the X-ray afterglow, a so-called L-T-E correlation has been found which tightly connects the isotropic energy of the prompt GRB (Eγ,iso) with the end time of the X-ray plateau (Ta) and the corresponding X-ray luminosity at the end time (LX). Here we show that there is a clear redshift evolution in the correlation. Furthermore, since the power-law indices of LX and Eγ,iso in the correlation function are almost identical, the L-T-E correlation is insensitive to cosmological parameters and cannot be used as a satisfactory standard candle. On the other hand, based on a sample including 121 long GRBs, we establish a new three parameter correlation that connects LX , Ta and the spectral peak energy Ep, i.e. the L-T-Ep correlation. This correlation strongly supports the so-called Combo-relation established by Izzo et al. (2015). After correcting for the redshift evolution, we show that the de-evolved L-T-Ep correlation can be used as a standard candle. By using this correlation alone, we are able to constrain the cosmological parameters as $\Omega m = 0.389^{+0.202}_{-0.141}$ (1σ) for the flat ΛCDM model, or $\Omega m = 0.369^{+0.217}_{-0.191}$, $w = -0.966^{+0.513}_{-0.678}$ 18 (1σ) for the flat wCDM model. Combining with other cosmological probes, more accurate constraints on the cosmology models are presented.

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Session Classification: Gamma-Ray Burst Correlations: Observational Challenges and Theoretical Interpretation

Track Classification: Fast Transients: Gamma-Ray Burst Correlations: Observational Challenges and Theoretical Interpretation