

KMI Colloquium

Gamma-Ray Bursts : Probe the dark energy and the CPT violation



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Abstract:

Gamma-ray bursts (GRBs) are the brightest explosions in the universe, and associated with the massive star explosions. The average redshift is about $z \sim 2$, and the most distant one is at $z=8.2$ (or $z=9.4$ in photometric observation). Therefore we can use GRBs as cosmological probing tool. In this talk, I will show two kinds of scientific results for the modern cosmology and quantum gravitation theory.

As the first topic, I introduce the extension of cosmic distance ladder with the Epeak--luminosity correlation of prompt emission of GRBs. As an application of the correlation, we measured the cosmological parameters, (Ω_m , Ω_Λ), at $z > 2$ beyond the Type Ia SNe. At present, the measured Ω_Λ is consistent with one of SNIa and CMB observations, and we conclude its time variation is not so large, like the cosmological constant.

As the second topic, I introduce the strictest observational verification of CPT invariance. We recently developed the Gamma-Ray Burst Polarimeter (GAP) aboard the solar sail IKAROS which is the first polarimeter specifically designed to measure the gamma-ray polarization of prompt GRBs. We detected the polarization signals from three bright GRBs in the cosmological distance. Some kinds of quantum gravitational theories predict the difference of the speed of light with right/left handed of circular polarization. We measured the effect with the information of measured gamma-ray polarization, and reported the CPT invariance is kept until 10^{14} times of Planck mass scale at least. This stringent limit on the CPT violating effect leads to the expectation that quantum gravity presumably respects the CPT invariance.