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Measuring the optical depth profile of galaxy clusters by the kinetic Sunyaev-Zel'dovich effect

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Abstract

baryonic matter distribution in the large-scale structures is one of the main questions in cosmology. This distribution can provide valuable information regarding the processes of galaxy formation and evolution. On the other hand, the missing baryon problem is still under debate. One of the most important cosmological structures for studying the rate and the distribution of the baryons is galaxy clusters. In this work, it is proposed that the kinetic Sunyaev-Zel'dovich effect in galaxy clusters, which has a supernova type Ia (SNe Ia) in their brightest central galaxy, can be used to obtain the optical depth profile of the galaxy cluster. To obtain this profile, the bulk velocity is calculated by SNe Ia. We show that for galaxy clusters in the redshift range of $z < 0.15$, we can find the optical depth with 100 kpc resolution, which is the same as 1 arc minute resolution in cosmic microwave background observations.

Keywords: baryonic matter, galaxy cluster, kinetic Sunyaev-Zel'dovich effect, supernova type I

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