Geophysical Research Abstracts
Vol. 16, EGU2014-3194-1, 2014
EGU General Assembly 2014

Axion as a cold dark matter candidate: low-mass case

Chan-Gyung Park (1), Jai-chan Hwang (2), and Hyerim Noh (3)

(1) Division of Science Education and Institute of Fusion Science, Chonbuk National University, Jeonju 561-756, Republic of Korea Korea (park.chan.gyung@gmail.com), (2) Department of Astronomy and Atmospheric Sciences, Kyungpook National University, Daegu 702-701, Republic of Korea, (3) Korea Astronomy and Space Science Institute, Daejon 305-348, Republic of Korea

Axion as a coherently oscillating scalar field can behave as a cold dark matter at all cosmological scales. For the conventional axion with mass around 10^{-5} eV, it shows a characteristic damping in the density perturbation on scales smaller than the solar system size, where the damping scale is inversely proportional to the square-root of the axion mass. We show that the axion mass smaller than 10^{-24} eV induces a significant damping in the baryon density power spectrum at cosmologically relevant scales, deviating from the cold dark matter within the axion Jeans scale. However, we note that with such a extremely small mass our basic assumption about the coherently oscillating scalar field is broken in the early universe. To avoid this problem, which is shared by other dark matter models based on the Bose-Einstein condensate and the ultra-light scalar field, we introduce a simple model with evolving axion mass in the early universe, and present observational effects of present low-mass axion on the baryon density power spectrum, the cosmic microwave background radiation (CMB) temperature power spectrum, and the growth rate of baryon density perturbation. In our low-mass axion model, the small-scale deviations from the cold dark matter in the power spectra clearly differ from the ones expected in the cold dark matter model mixed with the massive neutrinos. Reference: Phys. Rev. D 86, 083535 (2012)