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Ultralight ALP dark matter and 21 cm absorption signals in new physics

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A hypothetical particle known as the axion holds the potential to resolve both the cosmic dark matter riddle and particle physics' long-standing, strong CP dilemma. Unusual strong 21 cm absorption feature associated with the initial star formation era, maybe due to ultralight axion dark matter ($\sim 10^{-22}$ eV) at this time. The radio wave observation's 21 cm absorption signal can be explained as either anomalous baryon cooling or anomalous cosmic microwave background photon heating. Shortly after the axions and axion like particles (ALPs) thermalize among themselves and form a Bose-Einstein condensate, the cold dark matter ALPs make thermal contact with baryons, cooling them. ALPs are thought to be the source of some new evidence for dark matter, as the baryon temperature at cosmic dawn was lower than predicted based on presumptions. The detection of baryon acoustic oscillations is found to be consistent with baryon cooling by dark matter ALPs. Simultaneously, under the influence of the primordial black hole or intergalactic magnetic fields, the dark radiation composed of ALPs can resonantly transform into photons, significantly heating up the radiation in the frequency range relevant for the 21 cm tests. The two scenarios were considered. An interesting chance to investigate novel physics dynamics in the early cosmos is presented by the 21 cm cosmology.

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