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Imprints of cosmic reionization as a probe of dark matter nature in the post-reionization era

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We propose a novel mechanism for constraining warm dark matter (WDM) models via the so-called “memory of reionization” effect, which is that the thermal history of gas after cosmic reionization is sensitive to when the gas is reionized. The suppression of small-scale structure due to WDM affects the evolution of post-reionization gas, while thermal relics can couple to ionized bubbles at the scales of tens of Mpc. As such, the small-scale effect due to WDM can leave an imprint on the gas at large scales, which can be observed by Ly α forest and HI 21 cm intensity mapping. We forecast the accuracy of constraints on WDM using Ly α forest 3D power spectrum with DESI-like surveys, and 21 cm power spectrum with SKA1-LOW and PUMA surveys. We demonstrate that this approach can provide unprecedentedly tight constraints on WDM mass.

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