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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 Lyα forest and HI 21 cm intensity mapping. We forecast the accuracy of constraints on WDM using Lyα 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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