

Imprints of Non-thermal Wino dark matter on Small-Scale Structure

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We study how “warm” the wino dark matter is when it is non-thermally produced by the decays of the gravitino in the early Universe. We clarify the energy distribution of the wino at the decay of the gravitino and the energy loss process after their production. By solving the Boltzmann equation, we show that a sizable fraction of the wino dark matter can be “warm” for the wino mass $m_{\tilde{w}} \sim 100\text{--}500$ GeV. The “warmness” of the wino dark matter leaves imprints on the matter power spectra and may provide further insights on the origin of dark matter via the future 21 cm line survey. Our calculations can be applied to other non-thermal wino production scenarios such as the wino dark matter produced by the decay of the moduli fields.

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