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Constraining the Type 3 interacting dark-energy model using matter pairwise velocity

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Dark sector interactions can be explored via the so-called Type 3 model where dark matter and dark energy exchange momentum, so as to minimize deviations from the ΛCDM background expansion history, which agrees well with various observations. Using N-body simulations, we analyze the imprint of Type 3 model parameters, the momentum exchange coupling constant β and the slope of scalar field potential λ, on large-scale structure (LSS) observables, particularly the matter pairwise velocity statistics. We find that β and λ induce opposing effects on the mean matter peculiar pairwise velocity and velocity dispersion. Our results highlight the potential of velocity statistics as a probe of dark sector interactions and underscore the importance of disentangling β and λ in cosmological analyses.

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