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Exploring light dark matter boosted by supernova neutrinos in the present and past Universe

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It has been recently proposed that the boosted dark matter (BDM) by supernova neutrinos (SNν) from SN1987a or from the next Galactic supernova (SN) can serve as a novel component to probe nonvanishing interaction between dark matter (DM) and the standard model leptons. In this talk, I will introduce the relevant concept and evaluate the present-day *diffuse* flux of SNν BDM originated from all galaxies at higher redshifts. We show that by considering this diffuse BDM (DBDM) component, the best sensitivity on the product of the energy-independent DM-ν and DM-electron cross sections, $\sqrt{\sigma_{\chi\nu}\sigma_{\chi e}} \simeq \mathcal{O}(10^{-37})$ cm^2 for sub-MeV DM, can be obtained with large-size neutrino experiments such as Super-Kamiokande or Hyper-Kamiokande, surpassing the estimated SNν BDM bound from SN1987a. We also examine the impact due to the presence of DM spikes around the supermassive black holes in galaxies on SNν BDM and DBDM. Our results suggest that both the DBDM and the SNν BDM probes are robust to the uncertain properties of DM spikes, unless the next Galactic SN happens to occur at a location extremely close to or right behind the Galactic Center along the SN line of sight.

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