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Supernova Neutrino Physics with Xenon Dark Matter Detectors

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The dark matter experiment XENON1T is now operational and sensitive to all flavors of neutrinos emitted from a supernova through coherent elastic neutrino-nucleus scattering. We show that the proportional scintillation signal (S2) allows for a clear observation of the neutrino signal and guarantees a particularly low energy threshold, while the backgrounds are rendered negligible during the SN burst. XENON1T (XENONnT and LZ; DARWIN) will be sensitive to a SN burst up to 25 (40; 70) kpc from Earth at a significance of more than 5σ, observing approximately 35 (123; 704) events from a 27 $M_{\odot}$ SN progenitor at 10 kpc. Moreover, it will be possible to measure the average neutrino energy of all flavors, to constrain the total explosion energy, and to reconstruct the SN neutrino light curve. A large xenon detector such as DARWIN will be competitive with dedicated neutrino telescopes, while providing complementary information that is not otherwise accessible.

Summary

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