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Neutrinos in Nuclear Physics and Astrophysics and Japan-US Collaboration

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Neutrino is a tiny weakly interacting particle but plays several important and essential roles in nuclear physics, astrophysics and cosmology. Cosmological neutrinos take one of the keys to the formation of large scale structure and CMB anisotropies. Supernova neutrinos play critical roles in gravitational core-collapse and explosion of massive stars and also in explosive nucleosynthesis of light-to-heavy mass nuclei. In addition to these astrophysical interests, recent focus in neutrino physics is on the effects of flavor oscillation and self-interaction which indicate nature of fundamental symmetry or its breaking. Since these effects manifest themselves clearly through neutrino and matter interactions (i.e. neutrino-electron, -nucleon and -nucleus interactions), it is important to study the nuclear response to weak-electromagnetism. It is even more important to study the electroweak interaction as well as strong interaction in short-lived unstable nuclei because almost all catastrophic astrophysical phenomena occur on extreme conditions to be associated with frequent production and destruction of these exotic nuclei. Several Japan-US collaborations are underway on these topics in nuclear astrophysics. In this talk we will discuss several aspects of neutrinos in nuclear physics and astrophysics based on these collaborations.