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Isomers, the key to the origin of heavy elements and neutrino mass hierarchy

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Heavy nuclei are known to be produced by various nuclear processes such as r-, ν-, νp-, γ- and s-processes in massive stars as well as small-to-intermediate mass stars like AGBs. Several nuclear isomers in heavy nuclei play the critical roles in determining their final abundances. Especially, the first three r-, ν- and νp-processes among them are strongly affected by the ν-nucleus interactions which leave observational signals in nucleosynthetic products to constrain still unknown neutrino mass hierarchy. In this talk we will first show our Galactic chemical evolution studies of heavy nuclei and discuss that the supernovae (both ν-driven winds and magneto-hydrodynamic jet SNe), the collapsars (the collapse and explosion of very massive stars leaving a black hole instead of neutron star as a remnant) and the binary neutron-star mergers are the viable astrophysical sites for these explosive processes. We will then demonstrate that the nuclear isomers in ^{180}Ta, ^{92}Nb and ^{127,128}Cd play the critical roles in these processes. Combining nucleosynthesis of ^{180}Ta, ^{92}Nb, ^{138}La, ^{11}B, ^7Li, etc., we will propose how to constrain the neutrino mass hiererchy. We also suggest several isomers in the other nuclear systems which would affect explosive nucleosynthesis.

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