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Production of p-nuclei from r-process seeds: the νr-process

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We present a new nucleosynthesis process that may take place on neutron-rich ejecta experiencing an intensive neutrino flux. The nucleosynthesis proceeds similarly to the standard r-process, a sequence of neutron-captures and beta-decays, however with charged-current neutrino absorption reactions on nuclei operating much faster than beta-decays. Once neutron capture reactions freeze-out the produced r-process neutron-rich nuclei undergo a fast conversion of neutrons into protons and are pushed even beyond the β-stability line producing the neutron-deficient p-nuclei. This scenario, which we denote as the νr-process, provides an alternative channel for the production of p-nuclei and the short-lived nucleus ^{92}Nb. We discuss the necessary conditions posed on the astrophysical site for the νr-process to be realized in nature. While these conditions are not fulfilled by current neutrino-hydrodynamic models of r-process sites, future models, including more complex physics and a larger variety of outflow conditions, may achieve the necessary conditions in some regions of the ejecta.

[1] Z. Xiong, G. Martínez-Pinedo, O. Just, A. Sieverding, arXiv:2305.11050 (accepted by PRL)

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