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A new experimental technique for measuring (p,n) reactions relevant to the neutrino-p process in the ReA3 facility

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Neutrino driven winds (NDW) in core-collapse supernovae (CCSN) constitute an important astrophysical environment for nucleosynthesis, especially for the formation of elements beyond iron. If the right proton-rich conditions are found in the wind, nuclei with atomic numbers up to Z~50 can be produced via the so called neutrino-p (νp-) process. The strength of νp-process depends on a few key (n,p) reactions like the 56Ni(n,p)56Co and 64Ge(n,p)64Ga for which currently no experimental data exist. With the current state-of-the-art, any direct measurement of (n,p) reactions on neutron-deficient nuclei is extremely challenging. For this purpose, a new experimental technique has been developed at the ReA3 facility of the National Superconducting Cyclotron Laboratory for the study of astrophysically important (n,p) reactions via measuring their time-reverse (p,n) reactions in inverse kinematics. The main point of this technique is the separation of the heavy reaction products from the unreacted beam. This is properly achieved by operating a section of the ReA3 beam line as a recoil separator while using the LENDA neutron detector to tag the neutrons from the (p,n) reaction. At this stage, a proof-of-principle experiment has been performed using a stable 40Ar beam at 3.52 MeV/u in order to measure the 40Ar(p,n)40K reaction. In this presentation, a detailed description of the experimental method and results from the first proof-of-principle run will be shown.

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