Mass measurements of neutron-rich Ga isotopes performed at TITAN and their impact on the nucleosynthesis of the first r-process abundance peak

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Some of the nuclei involved in the formation of the first abundance peak of the r-process can be produced with the current rare isotope beam (RIB) facilities to measure their nuclear properties. The main challenges faced by the measurement techniques in this region are the low production rates together with a strong isobaric background from the N = 50 closed neutron shell. Multiple-Reflection Time-of-Flight Mass Spectrometers (MR-TOF-MS) are powerful devices which enable mass measurements of the most exotic nuclei under extreme background conditions thanks to their high accuracy, sensitivity, short cycle times and the possibility to be their own high-rate isobar separator.

Recently, an MR-TOF-MS was installed at TRIUMFs Ion Trap for Atomic and Nuclear science (TITAN), enabling high-precision mass measurements of neutron-rich Ga isotopes up to A = 85. The impact of the newly measured masses on the formation of the first r-process abundance peak was studied under similar conditions found in the ejecta of the blue kilonova seen after the GW170817 binary neutron star merger event. Large-scale nuclear reaction calculations were performed using two state-of-the-art reaction codes and a detailed investigation of the formation of the maximum abundance at A = 80 and A = 84 was carried out.