β-decay of neutron-rich Z~60 nuclei and the origin of Rare-Earth Elements

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A large fraction of the rare-earth elements observed in the solar system are produced in the astrophysical rapid neutron capture process (*r*-process). In the solar *r*-process abundance distribution, the peak at around A=160, is a prominent feature known as rare-earth elements (REE) peak. In contrast to the other two prominent peaks at around A=130 and A=195, which are associated with neutron shell closure[1], it has been argued that the formation of the REE peak may be related to the nuclear deformation[2].

To address this problem, a β-decay spectroscopy experiment was performed at RI Beam Factory (RIBF) of RIKEN, aimed at studying a wide range of very neutron-rich nuclei with Z~60 that are progenitors of the rare-earth elements with mass number A~160. This experiment was carried out using in-flight fission of 345MeV/nucleon ^{238}U primary beam. A stack of five highly-segmented double-side silicon strip detectors was employed to study implanted isotopes and their subsequent β-decays, in conjunction with high-purity germanium cluster detectors (EURICA).

In this experiment, about 27 new half-lives were measured with high statistics, including the half-lives of the rare-earth elements Pm, Nd, Pr, Ce, La. This contribution will present preliminary experimental results and discuss the formation of the REE peak.

[1] E. Burbidge, G. Burbidge, W. Fowler, and F. Hoyle, Rev. Mod. Phys 29, 547 (1957).
[2] P.-A. Söderström, Phys. Scr. T 150, 014038 (2012).