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On-line experimental results of argon gas cell based laser ion source (KEK Isotope Separation System)

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The beta-decay properties of nuclei with neutron magic number of $N=126$, which are believed to act as progenitors in the rapid neutron capture process (r-process) path forming the third peak ($A\sim 195$) in the observed r-abundance element distribution, are considered critical for understanding the production of heavy elements such as gold and platinum at astrophysical sites. As a first step of our project, we are going to produce and measure the half-lives of the nuclei with $Z=74-77$ around $N=126$.

We adopted the multinucleon transfer (MNT) reaction of ^{136}Xe beam and ^{198}Pt target system as the production of nuclei around $N=126$. The reaction system is considered to be one of the best candidates to efficiently produce the nuclei around $N=126$. In order to accumulate the reaction products efficiently and select our interesting nuclei with high purity, we have constructed the KEK Isotope Separation System (KISS) at RIKEN RIBF facility. KISS consists of an argon gas cell based laser ion source (atomic number selection) and an isotope separation on-line (ISOL) (mass number selection), to produce pure low-energy beams of neutron-rich isotopes around $N=126$ and to study their beta-decay properties.

We performed the off-line tests to study the basic properties of the KISS such as an extraction time from the gas cell and mass resolving power of the ISOL, and then conducted the on-line experiments to study the thermalization and neutralization processes of reaction products in the gas cell, and to measure the extraction efficiency from the gas cell and the extracted beam purity. We successfully extracted the laser-ionized stable ^{56}Fe (direct implantation into the gas cell of ^{56}Fe beam) atoms and ^{198}Pt (emitted from the ^{198}Pt target by elastic scattering with ^{136}Xe beam) atoms from the KISS at the commissioning on-line experiments. Then, we extracted laser-ionized unstable ^{199}Pt atoms and confirmed that the measured half-life was in good agreement with the reported value.

In this presentation, we will introduce the KISS project, the gas-cell system, the results of the KISS commissioning on-line experiments, and the perspective of the project.

Primary author: Dr HIRAYAMA, Yoshikazu (IPNS, KEK)

Co-authors: Prof. MIYATAKE, Hiroari (KEK); Dr ISHIYAMA, Hironobu (KEK); Mr OYAIZU, Michihiro (KEK); Ms MUKAI, Momo (University of Tsukuba); Prof. IMAI, Nobuaki (CNS); Mr KIMURA, Sota (University of Tsukuba); Prof. JEONG, SunChan (KEK); Mr KIM, YungHee (Seoul National University); Dr WATANABE, Yutaka (KEK)

Presenter: Dr HIRAYAMA, Yoshikazu (IPNS, KEK)

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