NEUTRON EXPERIMENT FOR THE STUDY OF Re/Os COSMOCHRONOMETER

M.Segawa†, Y.Nagai, T.Shima, H.Makii, K.Mishima, H.Ueda, Y.Temma, T.Masaki

Research Center for Nuclear Physics, Osaka University, 10-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

M.Igashira, T.Ohsaki

Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology, O-okayama, Meguro, Tokyo 152-8550, Japan

T.Shizuma, T.Hayakawa

Japan Atomic Energy Research Institute, 2-4 Shirakatashirane, Toukaimura, Ibaraki 319-1195, Japan

The age determination of the universe has been an interesting subject. It has been considered that the Re-Os pair can be one of good cosmochronometers, since it has unique features as discussed below[1]. Namely, ^{187}Re is produced by only r-process and the half life of ^{187}Re is quite long 42.3±1.3 Gyr. Here, since ^{186}Os is the s-only isotope, ^{187}Os is produced not only by the decay of ^{187}Re but also by the slow neutron capture process of ^{186}Os. Hence, principally if we know the production rate by the s-process neutron capture of ^{186}Os and the loss rate of ^{187}Os, we could obtain the amount of the decay product of ^{187}Re using the well known relation, $\sigma(^{186}\mathrm{Os})\mathrm{N}(^{1\ 86}\mathrm{Os}) = \sigma(^{187}\mathrm{Os})\mathrm{N}(^{187}\mathrm{Os})$[2]. Here, $\sigma(^{A}\mathrm{Os})$ and $\mathrm{N}(^{A}\mathrm{Os})$ stand for the neutron capture cross section and the observed abundance of Os isotope with mass number A, respectively. Consequently, we could deduce the age of the Galaxy. However, there is a problem which should be clarified. Namely, there exists the excited state at 10 keV in ^{187}Os. The state could be significantly populated at the stellar temperature of about 10^8K, and therefore ^{187}Os is depleted by the neutron capture process through the excited state[1]. Hence it is very important to find a proper way to correct for the loss rate of ^{187}Os through the excited state in deducing the age of the Galaxy[3]. In order to correct for the effect various kinds of experimental works were made[4,5].However, there is a discrepancy between different data sets. Hence in the present study we measured the neutron capture cross section of ^{186}Os, ^{187}Os and ^{189}Os for neutrons between 10 and 90 keV by detecting a promt γ-ray from these reactions using an anti-Compton NaI(Tl) spectrometer[6,7]. The neutrons were produced by the ^{7}Li(p,n)^{7}Be reaction using the pulsed proton beams provided from the Pelletron accelerator at Tokyo Institute of Technology. These cross sections were determined within uncertainties of 5-10 % in the measured energy reagion.We report preliminary results of these measurements.

Reference

[1]D. D. Clayton, Astropys. J. 139, 637 (1964)
[2]F. Käppeler, Prog. Nucl. Part. Phys, 43, 419 (1999)
[3]W. A. Fowler, Revs. Modern Phys, Vol. 56, No. 2, Part 1,April 1984
[4]R. R. Winters, R. L. Macklin, Phys. Rev. C 25, 208 (1980) ; R. R. Winters, R. L. Macklin, and J. Halperin, Phys. Rev. C 21, 563 (1980)
[5]J. C. Browne and B. L. Berman, Phys. Rev. C 23, 1434 (1981)
[6]S. Mizuno,M. Igashira, K. Masuda, Nuclear Science and Technology 36, 493 (1999)
[7]M. Igashira,H. Kitazawa, N. Yamamuro, Nucl. Instrum. Methods A245,432 (1986)

† *E-mail:* segawa@rcnp.osaka-u.ac.jp