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Studies of neutron-rich nuclear structures through beta-delayed decay of spin-polarized isotopes

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Much attention has been paid on the exotic structure of neutron-rich nuclei such those around magic numbers N = 8 and 20.
However, most of the information on the excited states of these nuclei, such as spin and parity, has not been known well. We have developed a new method to effectively investigate the level structure by taking advantage of asymmetric beta-decay of spin polarized unstable nuclei: The spins of the daughter states can be assigned unambiguously from the characteristic asymmetry.

We have started beta-delayed decay spectroscopy at ISAC-1 TRIUMF, where highly polarized radioactive nuclear beams are available.
In the first experiment measuring beta-delayed neutron decays of spin-polarized 11Li has successfully assigned the spins and parities of 7 levels in 11Be for the first time [1].

The experiment with polarized 28Na and 29Na beams have been performed in 2007. The beta-decay asymmetry parameters and gamma-ray intensities have also assigned spin-parity of a newly found level in 28Mg and of 7 levels in 29Mg for the first time. The observed levels and log-ft values were compared with the shell model calculations using NuShell code with USD interactions. The level energies, log-ft values and the decay properties of all the assigned levels were explained well by assuming sd-shell configurations. However, in 29Mg two levels at 1.095 and 1.430 MeV associated with large log-ft values could not be reproduced by the calculations. The Monte Carlo Shell Model calculation taking into account the intruder configurations predicted 3/2- and 7/2- levels around 1 MeV [2]. This fact strongly suggests negative parity assignments for the 1.095 and 1.430 MeV levels in 29Mg.
In August 2010 the experiment with 30Na beam has been performed and the data analysis is in progress now.

In the talk the principle of the method will be introduced and results on the 11Be, 28Mg and 29Mg structures will be discussed. Some of new findings on 30Mg structure will also be presented.

[1] Y. Hirayama et al., Phys. Lett. B611, 239 (2005).
[2] Y. Utsuno, private communication.

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