**Speaker : Tadashi SHIMODA**

# Structure of Exotic Nuclei Probed by Spin-Polarized Radioactive Beams*

**Tadashi SHIMODA**
*Department of Physics, Osaka University, Toyonaka, Osaka 560-0043, Japan*

Abstract

We have proposed a unique method to investigate the structures of the exotic nuclei by using spin-polarized unstable nuclear beams[1]. The essence of the method is the use of spatially asymmetric decay of β-transition from a spin-polarized nucleus. Since the β-decay asymmetry strongly depends on the spins and parities of the initial and final states, we can assign the spin-parity of the final states daughter by observing the asymmetry in coincidence with the successive decays to the β-decay.

The first application was successfully made[2] using the highly polarized $^{11}$Li beam at TRIUMF , where highly polarized radioactive nuclear beams were available by the collinear optical pumping for the fast neutral alkali beam. The excited states in the light neutron-rich nucleus $^{11}$Be have been studied through the β-delayed neutron- and γ-decays from polarized $^{11}$Li$_{g.s.}$. The level scheme and decay scheme of the excited states in $^{11}$Be were established from the β-γ, β-neutron and β-neutron-γ coincidences, and the spins and parities of 6 levels in $^{11}$Be were firmly assigned for the first time[2]. The detailed information on excitation energy, spin-parity, β-decay intensity, neutron-decay path, and spectroscopic factors of the neutron decay enables us to test stringently theoretical predictions. It is found that the excess neutrons in $^{11}$Be are not in the *p*-orbit as predicted by the conventional shell model but in the *s*-orbit. Some of the levels show good accord with the theoretical prediction by the Anti-symmetrized Molecular Dynamics[2]. It is concluded that various types of the cluster states exist in $^{11}$Be[2].

Another experiments[3] with polarized $^{28,29,30,31,32}$Na isotopes are ongoing at TRIUMF to investigate the structure of neutron-rich $^{28,29,30,31,32}$Mg isotopes with the neutron number $N$~20 (nuclei of the "island of inversion"), respectively. The most of spins and parities of the excited states in these nuclei have not been assigned yet. Our method will establish firm assignments.

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