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# Structure of neutron-rich Mg isotopes studied through $\beta$-delayed $\gamma$-decay of polarized Na isotopes

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Evolution of shell structures in a wide range of nuclear chart is one of the most important subjects in nuclear physics. In particular, breakdown of the $N = 20$ shell closure and onset of collectivity as increasing neutron number in neutron-rich nuclei in the region of so-called "island of inversion". In spite of intensive investigations for many years, little is known on the spin-parity of the levels in neutron-rich Mg isotopes. This situation has been preventing quantitative understanding of their structures.
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We have started systematic studies of neutron-rich Mg isotopes by using an effective method to assign spin-parity of their excited states. The essential is a use of spin-polarized Na isotopes. The allowed $\beta$-decay asymmetry, which strongly depends on the spins of the initial and final states, determines unambiguously the spins of the daughter states. The first application of this method was successfully made for the $\beta$-delayed neutron-$\gamma$ spectroscopy of polarized $^{11}$Li at the state-of-the-art ISOL-based radioactive nuclear beam facility ISAC of TRIUMF, which provides highly polarized alkali beams.
Detailed analyses enabled firm spin-parity assignments of six levels in $^{11}$Be for the first time \cite{Hirayama05}.
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As the first step of the systematic studies on Mg isotopes, $\beta$-delayed $\gamma$-decays from polarized $^{28}$Na and $^{29}$Na have been observed in November 2007. Preliminary analyses suggested that a new level and a revised spin assignment for $^{28}$Mg and determined spin-parity of two levels in $^{29}$Mg for the first time.
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The results will be presented and comparison with shell model predictions will be discussed.

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