Study of High-Spin States in A=30∼40 Nuclei

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Nuclear superdeformation is a unique testing ground for the shell structure at large deformation. Recent studies of nuclei in A $\sim$ 40 region elucidated superdeformed (SD) structures in the excited levels along the N=Z line whose ground state is spherical. Accordingly, 'a new island' of SD nuclei was found around A $\sim$ 40 region (i.e., ^{36,40}Ar[1, 2], ^{40}Ca[3], and ^{44}Ti[4]). The systematical presence of these SD structures is qualitatively understood by the SD shell gaps at N=Z=18, 20, and 22 appeared in the Woods-Saxon single-particle diagram (see Fig.. 4 of ref. [3]). Another SD shell structure at N=Z=16 is predicted and the associated superdeformation is predicted in ^{32}S for a long time [5], but it has not yet been observed and remains as a great challenge. Cranked Skyrme-Hartree-Fock calculations predict the SD structure in a range of sulfur isotopes [6]. ^{36}S and adjacent ^{35}S nuclei are candidates of SD nuclei. However, high-spin level structure of these isotopes are not well explored and only low-lying levels near the ground state are studied.

In order to study high-spin level structure and to investigate collective structure in ^{35}S, we have performed an in-beam γ-ray spectroscopy experiment at the tandem accelerator facility of Institute de Physique Nucléaire d'Orsay. High-spin sates of ^{35}S were produced by the fusion-evaporation reaction, ^{26}Mg(^{18}O, 2α1n)^{35}S at an ^{18}O beam energy of 75 and 80 MeV. Two stacked self-supporting foils of ^{26}Mg enriched isotopes with thickness of 0.5 mg/cm^2 were used. Gamma rays were measured by the ORGAM Ge detector array comprised of 13 EUROGAM type coaxial Ge detectors with the BGO Compton suppressor shield [7], in coincidence with charged particles detected by the Si-Ball, a 4π array consisting of 11 Δ E Si detectors [8]. After Doppler shift correction and setting gate on 2 α particles detected by the Si-Ball, γ-ray energy spectrum was created as shown in Fig. 1(a). By the charged particle gate, γ-ray peaks associated with 2 α events (^{34,35}S) were enhanced. By setting gate on the low-lying 1991 keV transition of ^{35}S, $\gamma-\gamma$ coincidence relations are examined. Further data analysis is now in progress.

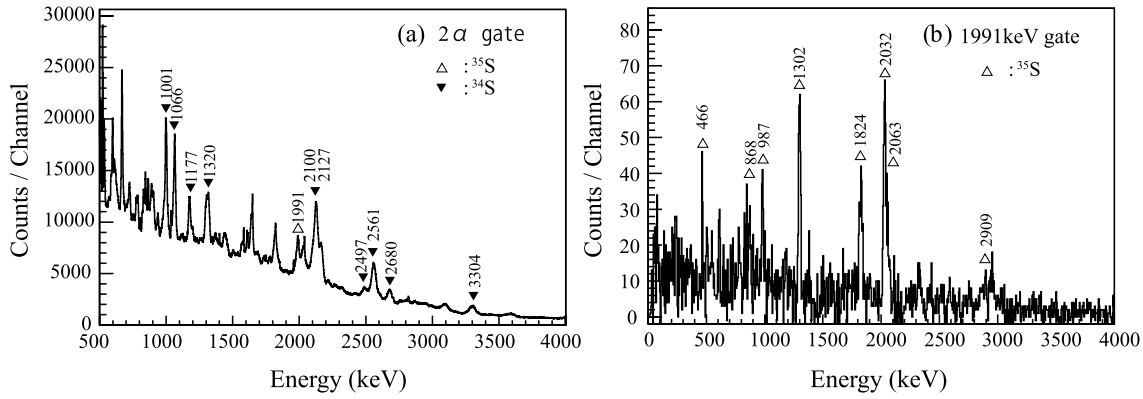

Figure 1: (a) Gamma-ray spectrum by 2 α particle gate. (b) Gamma-ray spectrum gating on 1991 keV transition.

References

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