Study of high-spin states in ^{35}S

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Superdeformed rotational bands in the mass 40 region have been discovered in ^{36}Ar,[1)] ^{40}Ar[2)] and ^{40}Ca[3)]. The occurrence of the superdeformed structure in this region is related to the existence of large energy gaps that are formed between the down-sloping $f_{7/2}$ and the up-sloping $d_{3/2}$ and $d_{5/2}$ orbitals, as can be seen in the Woods-Saxon single particle diagram in Fig. 1. The diagram also indicates the superdeformed structure in sulfur isotopes since there is a large energy gap at $Z = 16$. The spin-parity of the superdeformed band heads in odd-mass isotopes could give information about the orbital that drives the superdeformed structure. Therefore, we performed the in-beam gamma-ray spectroscopy to search for superdeformed states in ^{35}S at the Tandem-ALTO facility, Institut de physique Nucléaire d'Orsay.

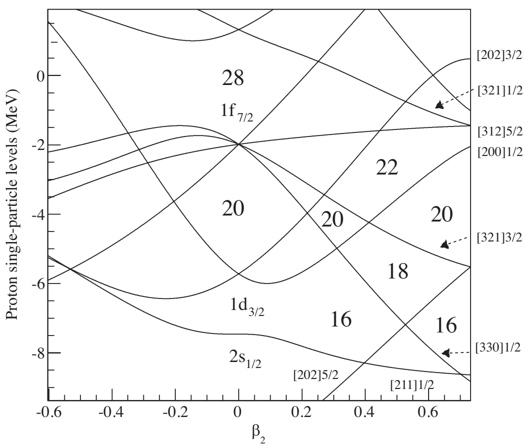

Fig. 1. Woods-Saxon orbitals as a function of the quadrupole deformation parameter β_2. The calculation was performed by the WSBETA code[4)].

High-spin states of ^{35}S were produced by the fusion evaporation reaction, ^{26}Mg(^{18}O, $2\alpha 1n$)^{35}S. ^{18}O beam energies of 75 and 80 MeV were used. The thickness of the ^{26}Mg target was 1 mg/cm^2. Gamma rays were measured using the ORGAM array consisting of EUROGAM germanium detectors[5)]. A total of 13 detectors were installed at 5 different angles. The energy loss of charged particles from compound nuclei was measured by Si-Ball[6)], a 4π array of 11 silicon detectors of 170 μm in thickness.

In order to identify high-spin states of ^{35}S, the gamma–gamma coincidence analysis was performed. For instance, the transitions reported in the previous study[7)] were observed by gating the de-excitation gamma ray from the first excited state at 1302 keV of ^{35}S (see Fig. 2). All possible energy gates were examined to construct the level scheme. Thus, an 1576-keV E2 transition from the excited state at 8.8 MeV was found. The half-life was estimated to be less than a few hundred femto seconds due to the existence of the residual Doppler shift of the transition[8)]. This means the transition has high-collectivity and indicates superdeformed band member in ^{35}S. Further analysis is being carried out.

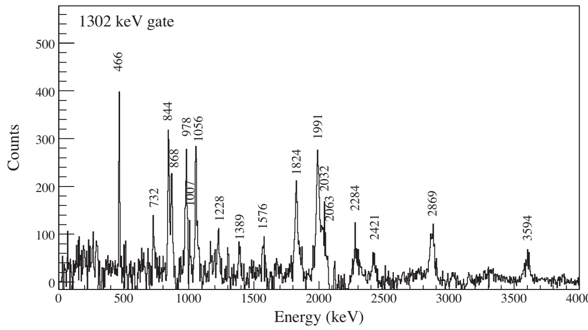

Fig. 2. Gamma-ray energy spectrum of ^{35}S in coincidence with the 1302 keV transition.

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