

3 - 10 Strongly Isospin-mixed Doublet in ^{26}Si Observed by β Decay of $^{26}\text{P}^*$

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In 1932, W. Heisenberg proposed the concept of isospin to describe the symmetry in atomic nuclei due to the similar behaviors between neutrons and protons in the strong force^[1]. However, the symmetry of isospin is approximate because of proton-neutron mass difference, Coulomb interaction, and charge-dependent parts of nuclear force. Such asymmetry leads to Fermi strength splitting into the isobaric analog state (IAS) and its neighboring states via strong isospin mixing, instead of focusing on only one state. Probing isospin mixing has gained considerable attention in β -decay studies. The β -decay experiment of ^{26}P was performed at the Heavy Ion Research Facility in Lanzhou (HIRFL) with a complex detection consist of double-sided silicon strip detectors operating in conjunction with the high-purity germanium detectors. The IAS at 13 055 keV and two new high-lying states at 13 380 and 11 912 keV in ^{26}Si , shown in Fig. 1, were determined via β -delayed two-proton emission of ^{26}P . The abnormal $\log ft$ values of IAS and 13 380-keV state indicate a strong isospin mixing between these two states. The isospin mixing matrix element is extracted to be 130(21) keV standing for the strongest mixing ever observed in β -decay experiments^[2].

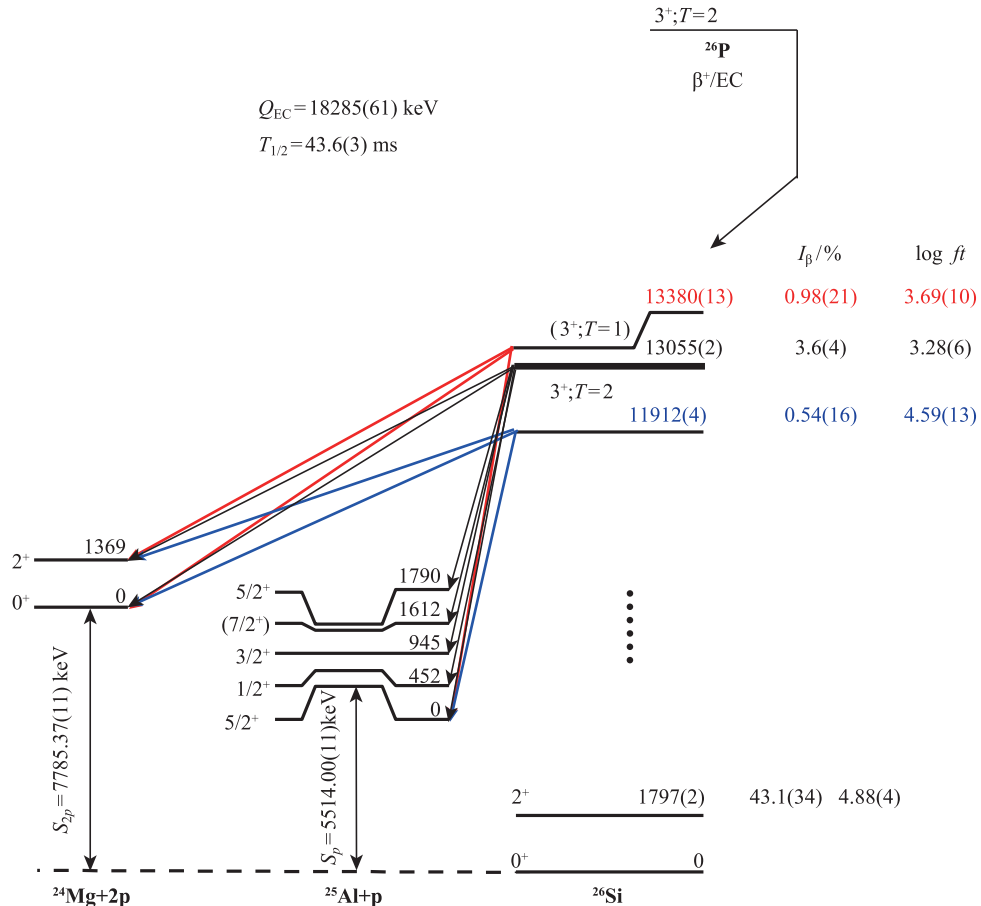


Fig. 1 (color online) The partial decay scheme of ^{26}P .

References

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3 - 11 Shape Coexistence in Neutron-Deficient Nuclei with $Z \sim 82$, $N \sim 104$ *

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Neutron-deficient nuclei around mid-shell at $N \sim 104$ in the lead region provide many cases of shape coexistence and shape isomers^[1,2]. In order to study shape coexistence in this region, prompt and delayed γ -ray spectroscopy of the ¹⁸⁷Pb, ¹⁸³Hg, ¹⁸⁸Bi and ¹⁸⁸Po nuclei produced by the fusion-evaporation reaction ⁵⁰Cr + ¹⁴²Nd \rightarrow ¹⁹²Po* has been performed at the Argonne Gas-Filled Analyzer. The recoil-decay tagging (RDT) technique was used to provide an unambiguous γ -ray assignment to a specific nuclide.

In ¹⁸⁷Pb, a new 5.15(15)- μ s isomeric state at 308 keV above the spherical 3/2⁻ ground state is identified. As shown in the left panel of Fig. 1, a strongly-coupled rotational band (Band 1 in Fig. 1) is observed on top of this isomer, which is nearly identical to the one built on the prolate 7/2⁻ [514] Nilsson state in the isotope ¹⁸⁵Hg. Based on this similarity, the new isomer in ¹⁸⁷Pb was proposed to be prolate with $J^\pi = (7/2^-)$ and classified as a shape isomer. The retarded character of the 308-keV (7/2⁻) \rightarrow 3/2⁻ gs transition with a deduced $B(E2) = 5.6(2) \times 10^{-4}$ W.u. can be well explained by the significant shape difference between the prolate initial and spherical final configurations. The combined results of the present work and the previous α -decay and laser spectroscopy studies exhibit the evidence for the triple spherical-oblate-prolate shape coexistence at low energy in the negative-parity configurations of ¹⁸⁷Pb, which is well reproduced by the potential-energy surface (PES) calculations as presented in the right panel in Fig. 1. For detailed discussion and result, please refer to the published paper^[3].

In ¹⁸³Hg, the decay of the nearly spherical 13/2⁺ isomeric state was first observed following the α decay of the 13/2⁺ isomer in ¹⁸⁷Pb. By the α - γ correlation measurement, the half-life of this isomer was measured to be $T_{1/2} = 290(30)$ μ s. As displayed in the decay scheme in Fig. 2, this isomer was proposed to deexcite by an unobserved low-energy M2 transition to the known 9/2⁻ member of a strongly prolate-deformed 7/2⁻ [514] band,