High spin structure of ^{90}Nb

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Introduction

The study of odd-odd nuclei provides a platform to investigate the underlying proton-neutron residual interactions. The odd-odd nuclei in mass 90 region are interesting because both the odd nucleons span the same $Z\sim40$, $N\sim50$ subshell space, providing a good testing ground to study the role of proton-neutron residual interaction and its influence on both the collective rotation as well as the single particle motion [1, 2]. The low-lying levels of ^{89,90,91}Nb can be described in the $\pi(p_{1/2}, g_{9/2})$ configuration space. High-spin states in these nuclei can be understood as the $\pi(p_{3/2}, f_{5/2}, p_{1/2}) \rightarrow g_{9/2}$ proton excitations and $\nu g_{9/2} \rightarrow (d_{5/2}, g_{7/2})$ neutron excitation across the $Z = 40$ and $N = 50$ shell gaps, respectively [3–6]. So for high-spin states a larger configuration space should be involved and even the excitation of the core has to be taken into account. Spectroscopy of nuclei in this region provides valuable information about the two body matrix elements corresponding to the effective residual interaction used in shell model calculations. The odd-odd nucleus ^{90}Nb, with three proton particles and one neutron holes with respect to $Z = 38$ subshell and $N = 50$ shell closure respectively is good candidate to study the single particle excitations in this region. The investigation of the structure of this nucleus may contribute to the understanding of different mechanisms responsible for the generation of high-spin states in this mass region[6]. To search new high spin isomers is also an interesting part of the exploration of ^{90}Nb nucleus. The level structure of the nucleus has been extended upto to an excitation energy of 10.98 MeV.

Experimental Details

In the present work, excited states of the ^{90}Nb nucleus were populated in the reaction ^{65}Cu(^{30}Si,αpn) at E_{lab} =137 MeV. The ^{30}Si beam was obtained from the 14 UD Pelletron LINAC Facility at the Tata Institute of Fundamental Research (TIFR), Mumbai. The target ^{65}Cu used in experiments were 850 μg/cm^2 self supporting and 1.04 mg/cm^2 on 13.8 mg/cm^2 ^{197}Au, fabricated by evaporation technique at the TIFR target laboratory. The emitted γ-rays were detected using an array of 19 Compton suppressed Clover detectors positioned at angles 157°(3 detectors), 140°(3 detectors), 115°(3 detector), 90°(4 detectors), 65°(3 detectors) and 40°(3 detectors). The pulse processing and data acquisition was carried out using the PIXIE-16 digitizer, from XIA LLC, based system associated with the γ-ray detection setup at TIFR [7]. The acquired data was sorted into symmetric as well as angle dependent $\gamma-\gamma$ matrices and $\gamma-\gamma-\gamma$ cube using the MARCOS [7] and the RADWARE [8] codes. The RADWARE package is also being used for the subsequent analysis.

Preliminary Results and Outlook

The level scheme of ^{90}Nb nucleus has been extended with addition of more than 20 new γ-ray transitions. The asymmetric angle dependent matrices have been used for determination of angular distribution ratios R_θ for multipolarity assignments. Polarization asymmetry of the γ-rays shall be extracted from the angle dependent polarization matrices, for determining their electromagnetic character. Fig. 1 illustrates typical spectra with gates on 756 keV and 576 keV transitions of ^{90}Nb nu-

cleus. The relevant level scheme is depicted in Fig. 2. Large basis shell model calculations

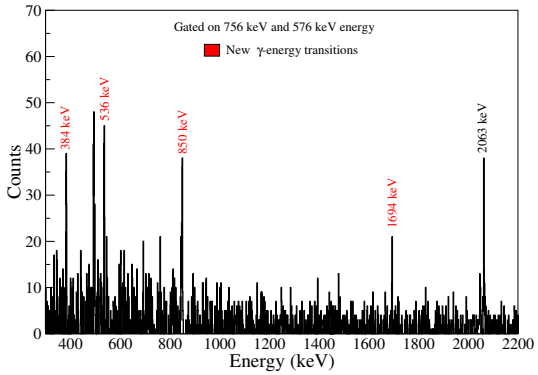

FIG. 1: 756 keV and 576 keV gated gamma spectrum showing the different transitions of ^{90}Nb.

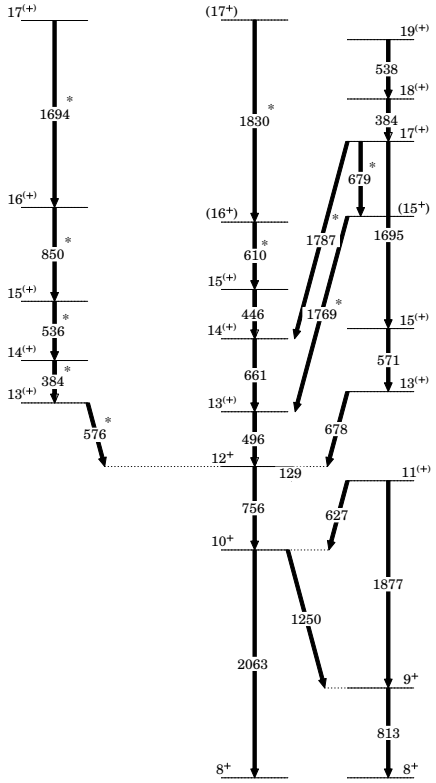

FIG. 2: Partial level scheme of ^{90}Nb showing new transitions with asterisk symbol.

is in progress to interpret the level structure of this nuclei as well as other nuclei in this mass region. The results of the analysis shall be detailed in the symposium.

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