Hindrance Factor Used in Systematic Configuration Specifying

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Introduction

The lifetime of nuclear excited state is a very important observable in nuclear spectroscopic studies. The transition probability is associated to the transition matrix elements of the initial and final wave functions of the states that make the transition. Experimental lifetime of a nuclear state provides essential information for comparison the nuclear models. The long lifetime is a sign of their unique structure and special kind of excited state. The study of isomers and their decay leads to a better understanding of the microscopic structure. There could be several underlying reasons for the long life of excited nuclear states, which form the basis for the classification of isomers. Accordingly, they are broadly classified into spin isomers, K-isomers, shape isomers and fission isomers. It is now common practice to compare the experimental half-life to the theoretical half-life and is defined as the hindrance factor. Typically, the Weisskopf hindrance factor [1–3] F_W, is defined as the ratio of experimental γ transition lifetime and the Weisskopf estimate [4]:

$$F_W = \frac{t^{\gamma}_{1/2}(experimental)}{t^{W}_{1/2}(Weisskopf\ estimate)}$$

here $t^{\gamma}_{1/2}$ is the partial γ-transition half-life, which is measured experimentally. The K−hindrance factor F_ν for K−isomer [5–7], is given as $F_\nu = (F_W)^{1/\nu}$, where $\nu = \Delta K - L$, and ΔK is the change in K, and L is the angular momentum carried by the emitted γ-ray photon. Here, K is the projection of the total angular momentum, *I*, on the symmetry axis.

For electric transitions, there is a strong indication that odd-neutron nuclei have indeed lower radiation probabilities than odd-proton nuclei [8]. For g factor, odd proton single quasi-particle states have higher g_R values and odd neutron single particle states lower g_R factor values than their even-even neighbors [9]. The systematic for g_R as a function of the difference between the numbers of proton and neutron quasiparticles $N_\pi - N_\nu$, in the K-isomer was discussed [10]. By considering the above effect of quasiparticle nature, we similarly modified the hindrance factor F_ν by adding $\pm(N\pi - N\nu)$, the effect of the difference between the numbers of proton and neutron quasiparticles involved in the K-isomer. In this analysis the hindrance factor will be empirically correlated with the Weisskopf hindrance factor.

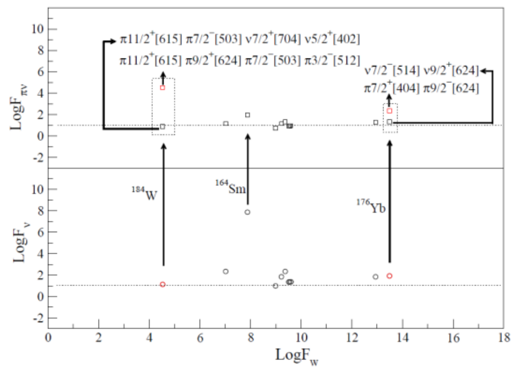

Fig. 1 The comparison of logarithmic of hindrance factors from present empirical

correlation Log$F_{\pi\nu}$ and known reduce hindrance Log$F\nu$ for various K−isomer states. The error was considered 10-20% and therefore, the errors marks come within the size of symbols make for data points.

The Log $F_{\pi\nu}$ values are in a linear pattern, and are found to be on the order of ~1. Any deviation in Log $F_{\pi\nu}$ from the smooth trend may imply a questionable that can be removed. The configuration of isomer state ($15^{\pm}$, Ex= 3863.2 keV) of ^{184}W [11] was assigned as either $\pi11/2^{+}$ [615] $\pi9/2^{+}$ [624] $\pi7/2^{-}$ [503] $\pi3/2^{-}$ [512] or $\pi11/2^{+}$ [615] $\pi7/2^{-}$ [503] $\nu7/2^{+}$ [704] $\nu5/2^{+}$ [402]). The LogF_{ν} values are same for both configurations. However, the Log$F_{\pi\nu}$ depends on the number of quasiparticles and has different values. The Log$F_{\pi\nu}$ values for the isomer state configurations $\pi11/2^{+}$[615]$\pi9/2^{+}$[624]$\pi7/2^{-}$[503] $\pi3/2^{-}$[512] and $\pi11/2^{+}$[615] $\pi7/2^{-}$ [503] $\nu7/2^{+}$ [704] $\nu5/2^{+}$ [402] are 4.53 and 0.91, respectively. Based on the systematic, the configuration whose Log$F_{\pi\nu}$ value is near to linear pattern or the order of 1 is preferred. Therefore, we preferred $\pi11/2^{+}$[615] $\pi7/2^{-}$[503] $\nu7/2^{+}$[704] $\nu5/2^{+}$[402] configuration instead of $\pi11/2^{+}$ [615] $\pi9/2^{+}$ [624] $\pi7/2^{-}$ [503] $\pi3/2^{-}$ [512].

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