

Cluster Radioactive Decay from Superheavy Nuclei

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Introduction

The spontaneous decay of radioactive nuclei with the emission of fragments heavier than α -particle is termed as Cluster Radioactivity or Exotic Decay. The phenomenon of Cluster Radioactivity was predicted by Sandulescu et al.[1] in 1980 and Rose and Jones [2] confirmed this in 1984 experimentally in the radioactive decay of ^{14}C from ^{223}Ra . This has triggered enormous research activity in the field of Cluster Radioactivity both experimentally and theoretically. Recently, the long lived (30s) superheavy nuclei with $Z = 114, 115, 116$ and 118 have been synthesized and detected by the Dubna group [3] by the decaying α chains with terminating spontaneous fission events. In the present study we considered the cluster radioactivity from the nuclei of superheavy region. In this region, the element with $Z = 114, A = 272$ and its isotopes with $A = 277, 280, 283$ and

285 are taken for the study. We studied the Cluster Decay based on CYEM [4] which fall under Unified Fission Model (UFM). This model uses a cubic potential in the pre-scission region connected by Coulomb plus Yukawa plus Exponential potential in the post-scission region.

Present Study

In the first phase of this work we have generated the exotic decay lifetimes for various cluster emissions ($^4\text{He}, ^{12}\text{C}$) from the above said element using cubic potential model. In the second phase the obtained lifetime values are compared with the values obtained by Poenaru et al. who used the Analytical Super Asymmetric Fission Model (ASAFM) [5]. In the third phase of this work the Geiger–Nuttal plots were plotted and studied for different clusters emitted from the considered element and its isotopes.

Results and Discussion

Figure 1 represents the sample results which compares the calculated logarithm of lifetime values obtained by ASAFM and CYEM for various cluster emissions from $^{277}\text{X}_{114}$. Our study reveals that the lifetime values calculated using CYEM model are in agreement with the values obtained by ASAFM. Figure 2 represents the Geiger-Nuttal plots of $Q^{-1/2}$ (MeV) versus $\log_{10}T_{1/2}(s)$ for various cluster emissions from $^{277}\text{X}_{114}$. The plot is found to be almost linear.

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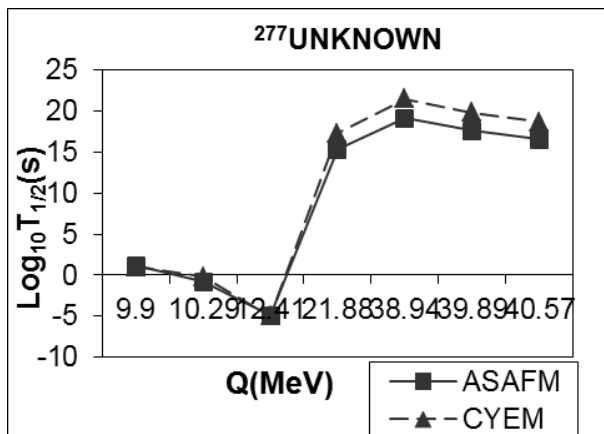


Figure 1: Comparison of calculated logarithm of lifetime values obtained by ASAFM and CYEM for various cluster emissions from the Super Heavy element $^{277}\text{Unknown}$.

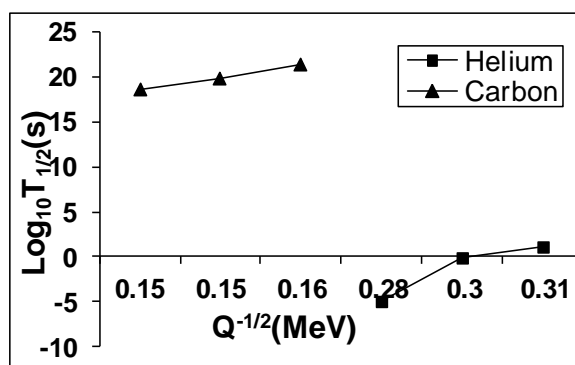


Figure 2: Geiger-Nuttal plot of $\log_{10}(T_{1/2})$ Vs. $Q^{-1/2}$ for various cluster emissions from the Super Heavy element $^{277}\text{Unknown}$.