

Study of Cluster Models for Fine Structure Effect in α -Decay and Exotic Decay

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INTRODUCTION

Preformed cluster models (PCM) and unified cluster models (UFM) are the two models on which the models of exotic cluster decay are broadly classified. They are mainly distinguished by the inclusion or non inclusion of the concept of cluster preformation probability P_0 . The inclusion of P_0 in PCM refers to the nuclear structure effects present in the decaying nucleus which are completely ignored in fission model. Thus the decay constant in a PCM is given by

$$\lambda_{\text{PCM}} = P_0 v_0 P$$

which in a UFM becomes simply

$$\lambda_{\text{UFM}} = v_0 P$$

Here V_0 and P are respectively the barrier assault frequency and the barrier penetration probability.

Cluster decay and α -decay are identical processes because of the existence of fine structure effects in cluster decay are similar to that observed in α -decay. Gamow theory of α -decay is the base of all theoretical attempts to explain the observed phenomena of cluster decay. The earlier theoretical attempts in this direction were based on simple Gamow theory, and assumed that clusters are already inside the nucleus. In these theories, the probability of tunneling of the cluster was calculated as a one dimensional WKB penetration probability through a nuclear square well potential plus a coulomb potential.

Rose and Jones¹ fitted their experimental cluster decay probability data to simple

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