

# Study of Fine Structure in Cluster Radioactivity of Alpha Decay and Exotic Decay

Author : Alka\* Co-Author : Shashi Bala\*\*

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## INTRODUCTION

Theoretically, cluster radioactivity was first predicted by Sandulescuseu Poenaru and Greiner<sup>1</sup> in 1980. This work was based upon the fragmentation theory<sup>2-9</sup> where the cold (fusion and fission) reaction valleys, were first observed in the calculated fragmentation potentials. According to the earlier calculations, cold reaction valleys are generated in the shell closure effects of one or both the reaction partners. Later, for the radioactive nuclei, the result of cold reaction valleys corresponding to observed cluster decay was depicted by Gupta et al.<sup>10</sup>

## EXPERIMENTAL SURVEY

Experimentally, Rose and Jones<sup>11</sup> in 1984 established the phenomena of cluster radioactivity. They observed for the first time spontaneous  $^{14}\text{C}$  decay of  $^{223}\text{Ra}$ . The decay of  $^{14}\text{C}$  has been observed in several other isotopes of radium nuclei and even more heavier cluster emission decay modes, like emission of  $^{20}\text{O}$ ,  $^{24,26}\text{Ne}$ ,  $^{23}\text{F}$ ,  $^{28,30}\text{Mg}$  and  $^{32,34}\text{Si}$ . Cluster from many radioactive nuclei have been observed by many experimental groups.

The experimental studies about the cluster have been extended to see if fine structure in cluster decay modes<sup>12-14</sup> is similar to that observed for  $\alpha$ -decay of radioactive nuclei by Rosenblum<sup>15</sup> in 1929, existed or not. It has been observed that fine structure in  $\alpha$ -decay is similar to that of the  $^{14}\text{C}$  Cluster decay of  $^{222,223}\text{Ra}$ . The fine structure in cluster decay arises because of the cluster decaying to the excited state or excited states of daughter nucleus, which is same as in case of  $\alpha$ -decay. But there is dissimilarity in  $\alpha$ -decay and fine structure in cluster decay. Fine structure in cluster decay is a very rare phenomena and the branching ratio for decay to excited states decreases very rapidly with an increase in the cluster size and the energy of the excited states.

The experimental methods which are used in detecting the spontaneous decay of radioactive nuclei through emission of clusters which are heavier than  $\alpha$  shows that

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\* Assistant Professor of Physics, Govt. Arya Degree College Nurpur, Distt. Kangra, Himachal Pradesh

\*\* Assistant Professor of Physics, Govt. Arya Degree College Nurpur, Distt. Kangra, Himachal Pradesh