Rare alpha (n)-FF event background imitator estimator

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Introduction

The experiments in low-energy physics are planned so that physically interesting effects mathematically are rare events, compared to others, whose probabilities are not small. Correspondingly, the purpose of the paper was the development of the formalism for the treatment of rare events, which definitely started for the recoil (ER) signal and after n-alpha particle signals is finished by the FF (fission fragment) signal in the same strip and vertical position of the focal plane PIPS detector (see. Eg.[1]). Special attention is played to the "active correlations" method, which applied to provide radical background suppression [2, 3].

Basic models to calculate the random coincidence probabilities and random event expectations

It was K.-H. Schmidt who first recognized the entire significance of probabilities estimates for the multi-chain events detected with a PIPS detector located at the focal plane of SHIP velocity filter recoil separator [4]. It developed a very frequently used by the experimentalist LDSC (linked decay signal combination) model. Another principal (basis) approach by V.B.Zlokazov [5] considers background signal combination (BSC) and test whether the signal sequence analyzed does fit in this concept or not. In the same time, a trend of every experimentalist to use parameters which can be extracted directly from the given experiment and not only the rates of the single signals which are imitated the ER's, alpha particle and FF signals during the long term experiment. Moreover, when one apply "active correlations" method one can separate different signal groups according to the elapsed time [6,7].
Note, that according to the model [7], we can consider the alpha beam stop's rates (as an incoming independent parameter) to calculate the expectation value of the random event.
In the same manner, if the statistics of the α(n) sequences is high enough with respect to one, it has become possible to use namely this cluster rate as an independent directly measured from the experiment parameter for given detector, strip, position etc.
Therefore, in the case of signal combination α(n) –FF is under experimentalists interest, expectations to obtain together with this cluster starting α(n) imitator signal for a time $t_{\alpha(n)\text{-FF}}$ and finishing FF signal for a time $t_{\alpha(n)\text{-FF}}$ can be rewrite as:

$$\overline{N}_R \approx N_{FF} \cdot P_{\alpha(n)FF} \qquad (1).$$

Here, $P_{\alpha(n)\text{-FF}}$ – is the probability to "detect" of group α(n) during a corresponding time interval before a FF signal for a time $t_{\alpha\text{-FF}}$.
Having applying in the manner similar to [4, 5] Poisson like statistics for the mentioned signal parameters we obtain:

$$\overline{N}_R \approx N_{FF} \cdot (1 - e^{-\lambda_{\alpha(n)} t_{\alpha-FF}}) \qquad (2).$$

In (2) parameter N_{FF} is the total number of FF signal for a given detector during the experiment.

File processor for chemical experiments with actinide targets

For file processing of the data, obtained from the heavy ion reactions the ***CEDV*** (***C***hemistry ***E***xperiment ***D***ata ***V***isualization: spectra formation-rates-correlations search etc.) RAD C++ Builder under Windows XP code has been designed. It allows to process files from the experiments performed at FLNR (JINR) in the field of superheavy elements [8]. One of the output results of its application is a list of α-α-α-FF correlations under definite time conditions. In the Fig.1 3D example is shown for three alpha particle signal for a given detector.

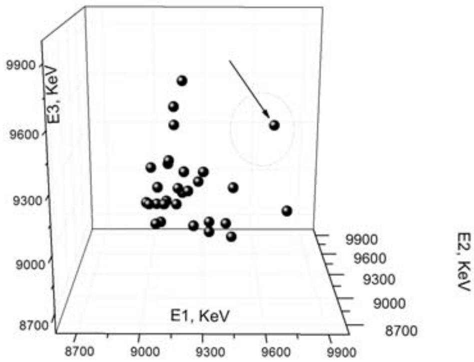

Fig. 1 3D picture of α-α-α group. Detected event indicated by the arrow. Left part-background signals.

If one use formula (2) for the given case the value of expectation of $N_R \approx 0.147$ for incoming parameters: 9300, 8800 and 9300 KeV as low energy limits and time intervals ≤100 s for first-second alpha particle interval and ≤50 s for second-third interval, respectively. In the Fig.2 low limit for $E_1=E_3$ is considered as a parameter under condition of fixed parameter E_2=8800 KeV.

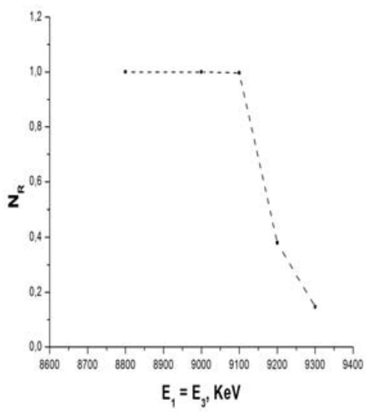

Fig. 2 Dependence of N_R parameter against the lower limits E_1 and E_3 for the fixed value E_2=8800 KeV.

Summary

Approach to calculate random expectation value for heavy ion induced complete fusion reactions has been proposed. It is applicable if a number $N_{\alpha(n)}$ of α(n) combination signals can be directly extracted from the experimental data for the interesting energy and time intervals. Of course, it is assumed that $N_{\alpha(n)}$ >>1 in an ideal case.

Note that the present estimate method gives higher value than one, given from LDSC method [4]. In the Ref. [9] LDSC method gives the lower with respect to other methods NR value too.

References

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