

FLUCTUATION ANALYSIS IN DETERMINING PREEQUILIBRIUM
CONTRIBUTION TO HEAVY ION REACTIONS

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The spectrum of particles emitted in reactions induced by nucleons or light ions shows the presence of a high energy tail which has been interpreted as preequilibrium emission. Recent experimental data show a significant presence of preequilibrium emission also in reaction induced by heavy ions. This kind of mechanism is expected to be particularly effective when the excitation energy of the composite system is comparable with the nucleon binding energy in the projectile times the initial exciton number. If the conditions for the presence of statistical fluctuations in the emission spectrum are achieved, then the appearance of a coherence width larger than the value corresponding to evaporation may be considered as an indication of the presence of a MSCE¹⁾ mechanism.

The extension of Ericson's theory to the contemporary presence of preequilibrium and compound nucleus fluctuations makes it possible the evaluation of the coherence widths relative to the two processes by means of the spectral density analysis, in the case the various coherence widths are different enough from each other. This method also allows the evaluation of the mean contributions of the two reaction mechanisms to the experimental cross section.

In this note we report the analysis of the $^{197}\text{Au}(^6\text{Li},p)X'$ reaction at $E_{\text{lab}}=74.8 \text{ MeV}^2$). Though the excitation energy is less than the Blann value corresponding to a complete separation of ^6Li into six excitons, one may think the equilibration chain to be initiated by a lower number ($n_0 < 6$) of excitons, due to the separation of ^6Li into complex particles.

The results of the spectral density analysis are reported in Figure 1 and in Table 1. Part a) of the figure shows a semilog graph

of the spectral density function $w(\beta)$ after trend elimination. The straight line is a least square fit of the final points whose slope determines the smaller coherence width Γ_1 ³⁾. Part b) shows the spectral density function after the subtraction of the contribution relative to Γ_1 , this allowing the

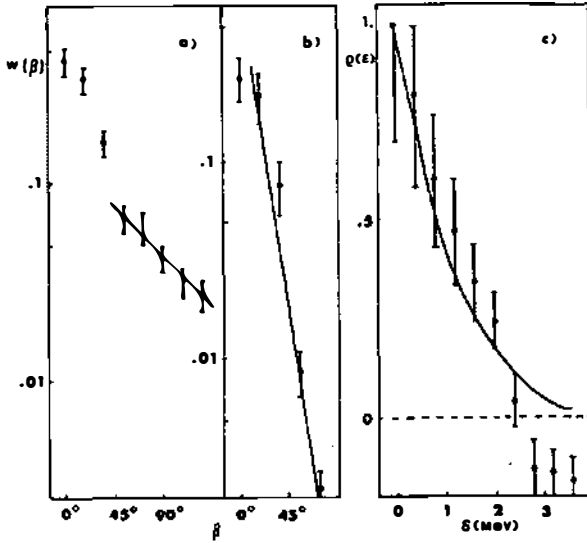


Figure 1

Table 1.

Γ (Kev)	A(%)	$\langle \sigma \rangle / \langle \sigma_T^{th} \rangle$
337 ± 71	30 ± 10	.16
1223 ± 76	70 ± 10	.84

extraction of a bigger coherence width Γ_2 . In each case the weights, A_1 and A_2 , of the widths may be calculated determining the intercept of the straight line with the $\beta = 0^\circ$ axis. In part c) the usual normalized autocorrelation function $\rho(\epsilon)$ is reported.

Its fit with the sum of two

Lorentz curves, corresponding to Γ_1 and Γ_2 and having A_1 and A_2 as weights, is also shown. Only two different coherence energies are present after trend elimination. The first one, $\Gamma_1 = (337 \pm 71 \text{ KeV})$, is probably due to compound nucleus evaporation, while the second one, $\Gamma_2 = (1223 \pm 76 \text{ KeV})$, may be attributed to the presence of a precompound emission mechanism. The relative weights of the two widths are shown in column 2 of Table 1 and in column 3 the relative values of the mean contributions of compound and precompound emission to the fluctuating part of the experimental cross section are reported.

1) H Feshbach: Ann. Rev. Nucl. Sci. 30(1980)240

2) P. Mooney et al.: Phys. Lett. 98B(1981)240

3) A. De Rosa et al.: Nuovo Cimento 58A(1980)254