# Fragment mass distributions from the statistical decay of $^{200}$Pb

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Fragment mass distribution study in the relatively neutron deficient Hg-Pb region is considered very important to look for possible anomalies in the mass distribution data [1]. The unexpected observation of quasi-fission (QF) in the fission of certain nuclei in the said region has led to the renewed interest to further explore similar reactions using mass distribution as a probe [2]. QF represents the decay of excited composite system before achieving the full equilibration and relatively broader mass distributions for select reactions in the studied energy domain signify the presence of QF. Considering the theoretical interpretation of the QF process, we still lack any comprehensive model which could predict and describe the properties of the said process. The statistical model calculations of the width of the mass distribution are carried out assuming the saddle point temperature (T) and mean square angular momentum (¡l$^2$¿) dependence of the variance of the fragment mass distribution having a functional form [3]

$$\sigma_m(u) = \sqrt{\alpha T + \beta < l^2 >} \qquad (1)$$

where, $\alpha$ and $\beta$ are fitting constants. The saddle-point temperature is calculated using the formalism of Knyazheva et al [5] and mean square angular momentum is estimated using couple channel code CCFULL [6]. In the present calculations, we have compared the experimental fragment mass distributions from the fission of $^{200}$Pb populated using $^{16}$O + $^{184}$W and $^{19}$F + $^{181}$Ta reactions [2], with the simulated decay of the same nucleus using statistical model code gemini [4] over the matching excitation energy range. Fig. 1

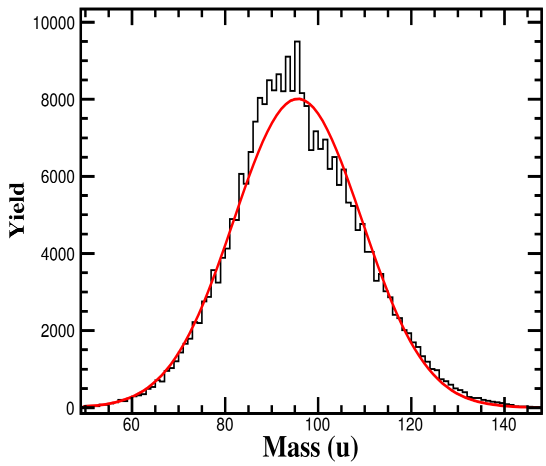


FIG. 1: Mass distribution (black histogram) from the fission of $^{200}$Pb at E* = 75 MeV. Red line represents the gaussian fit.

shows the calculated fragment mass distribution at 75 MeV of excitation energy. The distribution obtained is single peaked and is well reproducible by a single gaussian.

The calculated variance of fragment mass distributions from the statistical decay of excited $^{200}$Pb compound system along with the data obtained from the experimentally studied excitation energy range for the reaction $^{19}$F + $^{181}$Ta, is shown in Fig. 2. Though the data shown in figure 2 is from one of the two studied reactions, but, experimental variance obtained from the other reaction also has nearly matching behaviour. As shown by A. Chaudhury et al., the smooth slope of the experimental data, as obtained from the linear fit, for both the reactions, does not show presence of any non-compound processes. Moreover, width of the

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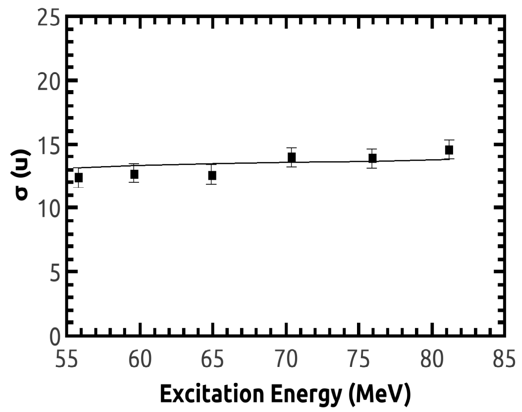


FIG. 2: Experimental mass variance (black squares) from the fission of $^{200}$Pb pouplated using $^{19}$F + $^{181}$Ta reaction. Continous line represents the variance from the model calculations.

distribution calculated using model code gemini over the studied energy range, agrees reasonably well with the experimental variance without introducing any normalization. The fission width in the gemini is calculated using the formalism of Bohr-Wheeler and Morreto [7, 8].

The calculated variance increases with the increase in energy with a slope of 0.023. As shown in [2], experimental variance is also well reproducible using the formalism of equation 1. In order to further explore the l-dependence of mass distribution, decay of excited CN was followed for fixed angular momentum with varying excitation energy. Again, distributions does not show any asymmetric behaviour and were reproducible by a single gaussian. The variance of the distributions calculated using above constraint also showed no significant change over the experimentally studied energy range.

Even though the populated system, i.e., $^{200}$Pb, is relatively neutron deficient and belongs to the region dominated by anomalies in fragment mass distributions, still, in the present study, experimental data does not show any unexpected trends in the mass distributions and the same is well reproduced using the statistical model code gemini.

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