

First chance fission probability of neighboring Po isotopes ^{*}

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Fission excitation functions of four neighboring polonium isotopes, $^{209,210,211,212}\text{Po}$, have been precisely measured in ^3He and ^4He induced reactions with isotopic lead targets at the 88-Inch Cyclotron to experimentally determine first chance fission probabilities. An estimate on the latter is essential to test the validity of the recently observed transition state scaling and to extract fission transient times. In the formalism described in Refs. [1,2], we have only accounted for 1st chance fission while for the experimental data we have the measured total fission probability. This approximation is certainly correct at low excitation energies where 1st chance fission is the dominant contribution. However, at higher energies, multi-chance fission is expected to become more important. Thus, the percentage of 1st chance fission will decrease.

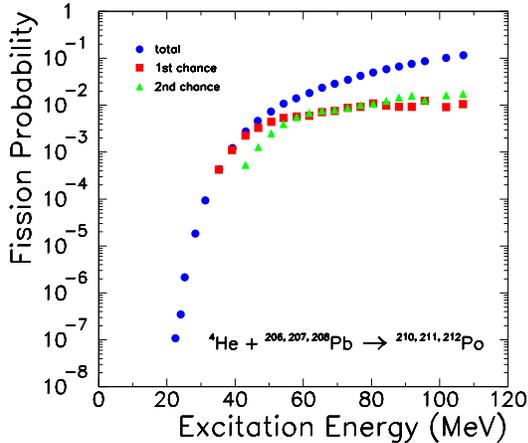


FIG. 1. First and second chance fission probabilities for the reaction $^4\text{He} + ^{206,207,208}\text{Pb}$. (Preliminary.)

The difference in the cumulative fission probability of neighboring isotopes can be used to determine the 1st chance fission probability. Since the energy dependence of the first chance fission probability is determined by subtracting similar cross sections, it is essential to measure the cumulative cross sections with high precision; see Ref. [3]. First chance fission at a given excitation energy can be determined by subtracting the fission probabilities of two neighboring isotopes by using the separation energy of the last neutron and the temperature of the daughter nucleus given by $T = \sqrt{E^*/a_n}$. We note that the angular momentum dependence is neglected in this simple ansatz.

In Fig. 1, we show the preliminary results of this analysis for ^4He induced reactions. At excitation energies smaller than ~ 45 MeV, 1st chance fission accounts for practically all the fission yield. However, at higher excita-

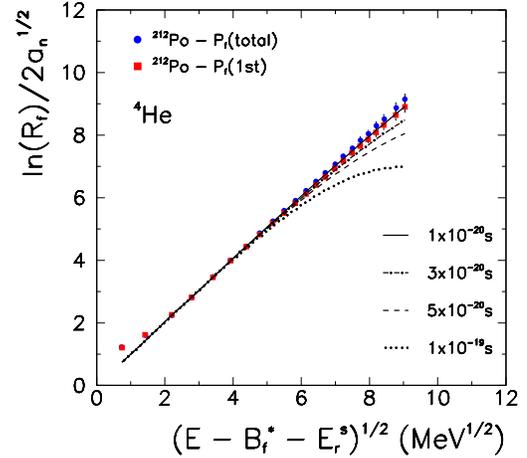


FIG. 2. The quantity $\frac{\ln R_f}{2\sqrt{a_n}}$ vs the square root of the intrinsic excitation energy over the saddle for fission of the compound nucleus ^{212}Po investigating both the total fission probability and the 1st chance fission probability only. The lines represent calculations assuming that no fission occurs during a given transient time which is indicated in the figure.

tion energies, multi-chance fission sets in and 1st chance fission only accounts for $\sim 10\%$ of the total fission probability at the highest excitation energies investigated. It is interesting that 2nd chance fission becomes somewhat stronger than 1st chance fission around 100 MeV.

As pointed out before, the formalism used in Ref. [2] has been established for first chance fission only. In Fig. 2, we show the scaled fission excitation functions for both 1st chance and the total fission probability. Although there is a small difference between the two cases at high excitation energies, no significant deviations from the straight line are visible. Similar results have been obtained for the other ^3He and ^4He induced fission reactions. We thus conclude that the 1st chance fission probability scales as the transition state method predicts and that fission transient times must be shorter than 30 zs. It seems likely that any excess precission emission occurs during the descent from saddle to scission. If this is the case, then the present fission results are not in contradiction with recent measurements of precission neutron and γ rays.

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- [1] , ^{*} Th. Rubehn *et al.*, LBNL-39895 (1997).
 - [2] Th. Rubehn *et al.*, Phys. Rev. C **54**, 3062 (1996) and this report.
 - [3] Th. Rubehn *et al.*, Nucl. Instr. Meth. A (in print); LBNL-39398; Los Alamos e-print nucl-ex/9609004; and this report.