Comparison of the isotopic cross sections measured in the fragmentation of ^{136}Xe and ^{124}Xe projectiles with the EPAX parameterization

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It is one of the main interests of the present research to extend the experimental investigations towards the rarely produced isotopes with extreme *N/Z* in order to investigate their structure properties or to study the dependence of the nuclear equation of state on the isotopic composition of the system. To produce these exotic nuclei experimentally a reliable description of the production cross sections is necessary to predict the production rates. The most recent and frequently used parameterization of the production cross sections is EPAX developed in [1,2].

In two experiments recently performed at the Fragment Separator at GSI, the isotopically resolved residues over the broad range of the nuclear charge were measured in the fragmentation of ^{136}Xe and ^{124}Xe in a lead target at 1 A GeV. The isotopic distributions measured in these experiments form an extensive database for testing the predictive power of the cross-section parameterizations especially from the point of view of the *N/Z* dependence.

To obtain a more complete overview on the predictive power of EPAX, the measured isotopic distributions of elements *Z*=15,45,50 in both experiments are compared with EPAX in Figure 1.

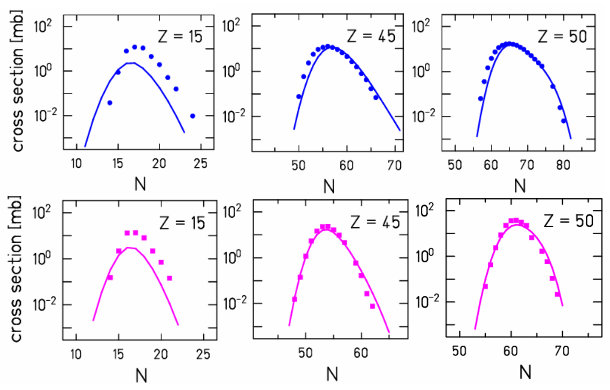

Figure 1: The isotopic distributions measured in ^{124}Xe+Pb (pink squares) and ^{136}Xe+Pb (blue squares) experiments for *Z*=15,45,50 compared with the EPAX (full lines).

It may be observed that the production cross sections of the lighter elements are strongly underestimated by EPAX in case of both projectiles. The production cross sections on the neutron-deficient side of the isotopic distributions for heavy elements are slightly underestimated by EPAX in case of the ^{136}Xe projectile. To obtain a complete overview on the isotopic composition of the final residues predicted by EPAX, the mean N-over-Z is compared with the experimental data in Figure 2.

The discrepancy between the experimental data and the EPAX in the vicinity of the ^{136}Xe projectile may be understood due to rather limited experimental information available for the n-rich system used to establish the EPAX parameterization. While in case of the less n-rich xenon projectiles (^{124}Xe, ^{129}Xe [3,4]) a broader range of heavy isotopes in the nuclear charge range *Z*~40-55 was available, the experimental data for the ^{136}Xe [5] projectile were much scarcer and concentrated only on the n-rich side of the isotopic distribution.

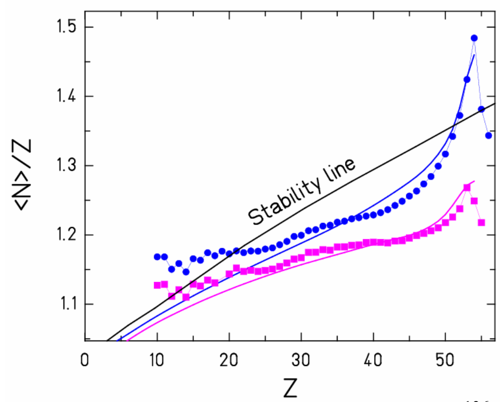

Figure 2: Comparison of the <*N*>/*Z* measured in ^{136}Xe+Pb (blue points) and ^{124}Xe+Pb (pink squares) reactions with the prediction of the EPAX parameterization (blue and pink lines).

Similarly, the discrepancy observed for the lighter residues may be traced back to the fact that only residues in the vicinity of the lighter projectiles were available to establish the EPAX parameterization. These residues are generally produced in more peripheral collisions where low to moderate excitation energies are introduced. On the contrary, the residues far away from the projectile are predominantly produced in more violent collisions, where considerably higher excitation energies may be expected. A highly excited nuclear system may undergo break-up into fragments of various sizes, a process, which contributes to an enhanced production of the intermediate-mass fragments (IMF, $3 \leq Z \leq 20$). This may provide an explanation of the underestimation of the production cross sections by EPAX in this nuclear-charge range.

The presented experiments provide experimental data in a much broader mass and *N/Z* range than covered by previous experiments. This new information will help improving the EPAX parameterization for nuclei around mass 100.

References

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