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Fusion-fission dynamics at higher excitation energies with 16O projectile

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Fast fission, quasifission, and pre-equilibrium fission are examples of non-equilibrium phenomena that impede the synthesis of super heavy metals by heavy-ion-induced reactions [1].
Understanding the kinetics of these processes requires accurate measurements of mass-energy distributions across a broad range of excitation intensities and compound nuclei.
The growing complexity with increasing excitation energies is a major obstacle to achieving regular measurements of pure fission fragment mass distributions at high energies. Numerous reaction channels, such as compound nuclear fission, quasi-elastics, deep inelastic reactions, fast fission, and quasi-fission events, are the source of this complexity [2]. In intermediate or high-energy nuclear processes, it gets increasingly harder to distinguish fission events from other reaction products.

To gain a deeper understanding of the kinetics of fusion-fission events at relatively high excitation energies, we present measurements from various reactions involving a 16O projectile, with energies generally ranging between 7 and 10 MeV/A. Our research has revealed the occurrence of fast fission events characterized by a mass imbalance of approximately 0.22 [3], particularly at higher excitation energies. These findings suggest the presence of rapid fission processes under these conditions.
Experiments with heavier beams and at higher energies are expected to provide critical insights into the systematic nature of these fast fission processes. Such investigations will help to understand the underlying mechanisms and characteristics of fission dynamics at elevated excitation energies. The recently operational K500 Superconducting Cyclotron facility is currently hosting a series of experiments aimed at further exploring these phenomena, offering a unique opportunity to enhance our understanding of fusion-fission dynamics and refine existing theoretical models

Reference:

1] D. Hinde et. al., Progress in Particle and Nuclear Physics 118, 103856, (2021).
[2] E. Vardaci et. al., Phys. Rev. C 101, 064612 (2020).
[3] K. Atreya et. al., Phys. Rev. C 109, 064620 (2024).

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