New neutron-rich isotope production in $^{154}\text{Sm}^{+}^{160}\text{Gd}$

Ning Wang$^1$ and Lu Guo$^{2,3}$

$^1$Department of Physics, Guangxi Normal University, Guilin 541004, People’s Republic of China
$^2$School of Physics, University of Chinese Academy of Sciences, Beijing 100049, China
$^3$State Key Laboratory of Theoretical Physics, Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing 100190, China

Deep inelastic scattering in $^{154}\text{Sm}^{+}^{160}\text{Gd}$ at energies above the Bass barrier is for the first time investigated with two different microscopic dynamics approaches: improved quantum molecular dynamics (ImQMD) model and time dependent Hartree-Fock (TDHF) theory. No fusion is observed from both models. The capture pocket disappears for this reaction due to strong Coulomb repulsion and the contact time of the di-nuclear system formed in head-on collisions is about 700 fm/c at an incident energy of 440 MeV. The isotope distribution of fragments in the deep inelastic scattering process is predicted with the simulations of the latest ImQMD-v2.2 model together with a statistical code (GEMINI) for describing the secondary decay of fragments. More than 40 extremely neutron-rich unmeasured nuclei with $58 \leq Z \leq 76$ are observed and the production cross sections are at the order of $\mu b$ to mb. The multi-nucleon transfer reaction of Sm+Gd could be an alternative way to synthesize new neutron-rich lanthanides which are difficult to be produced with traditional fusion reactions or fission of actinides.