Production of radon and thorium isotopes near \( N=126 \) shell closure in \( 48\text{Ca} \) and \( 54\text{Cr} \) induced fusion reactions on \( 162\text{Dy} \)

DMITRIY MAYOROV, TYLER WERKE, MARISA ALFONSO, CHARLES FOLDEN, Cyclotron Institute, Texas A&M University — Production of spherical evaporation residues (EVRs) near \( N=126 \) shell in \( 48\text{Ca} \) and \( 54\text{Cr} \) induced reactions on a \( 162\text{Dy} \) target was investigated at the Texas A&M University Cyclotron Institute using the vacuum separator MARS. For the \( 54\text{Cr}+162\text{Dy} \) reaction, only upper limits for the \( 4n \) exit-channel cross section were measured; this can be attributed to a sizably increased fissility of the \( 216\text{Th} \) compound nucleus relative to \( 210\text{Rn} \) formed in the \( 48\text{Ca} \) bombardment. A factor of \( >7300 \) separates the production cross sections of the \( 4n \) EVRs from each reaction. A semi-empirical estimate of the lower limit on the fusion probability, \( \text{PCN} \), ratio between the two heavy ion projectiles is \( \text{PCN}(48\text{Ca}+162\text{Dy})/\text{PCN}(54\text{Cr}+162\text{Dy}) > 1.2 \). Investigation of spherical nuclei produced by heavy ion fusion reactions is of current interest due to efforts to synthesize superheavy nuclei near \( Z=120, N=184 \) nucleon shells. EVRs produced near the \( N=126 \) shell closure have previously revealed surprisingly low survival probabilities despite stabilization from shell effects. Similarly, enhancement of the fission channel in the de-excitation cascade of \( 210\text{Rn} \) and \( 216\text{Th} \) is observed in this work and this result can be well modeled by the inclusion of collective effects into the statistical decay of excited nuclei calculations. These results suggest that cross sections for production of superheavy nuclei near predicted \( Z=120, N=184 \) closed shells may be small regardless of the anticipated strong shell effects.

Dmitriy Mayorov
Cyclotron Institute, Texas A&M University

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