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Recent theoretical investigation for the synthesis of superheavy elements using the DNS model

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Recent research has primarily focused on fusion reactions induced by heavy-ion collisions involving projectiles such as ^{51}V and ^{50}Ti as potential pathways to extend the known isotopic ranges and to explore new elements. The synthesis pathways of superheavy elements are modeled using the dinuclear system (DNS) approach [1, 2]. The DNS model comprehensively calculates the capture cross section and fusion cross sections, incorporating nuclear structure effects, deformation, and shell corrections that significantly impact fusion probability.
${}_{ER}(E_{c.m.},\ell) = {}_{cap}(E_{c.m.},\ell) \cdot P_{CN}(E_{c.m.},\ell) \cdot W_{sur}(E_{c.m.},\ell)$. (1)
The reactions ^{50}Ti+^{244}Pu and ^{50}Ti+^{251}Cf were examined theoretically, highlighting their potential for the synthesis of elements 116 and 120. ER cross sections for the ^{50}Ti+^{244}Pu reaction, displaying a peak cross section in the 4n neutron evaporation channel at ${}_{ER}$ =0.58 pb, closely aligning with experimental results from recent studies [3]. For the ^{50}Ti+^{251}Cf reaction aimed at synthesizing element 120, significant cross sections of 0.34 pb and 0.23 pb were predicted for the 3n and 4n channels respectively, highlighting this reaction as a promising candidate.
Theoretical predictions for the synthesis of element 119 through the ^{51}V+^{248}Cm reaction indicate a maximum evaporation residue cross section of 12.3 fb at the center-of-mass energy of 232 MeV for the 4n evaporation channel [4]. These results are consistent with prior theoretical predictions, underscoring the reliability and predictive capability of the DNS model in guiding experimental searches for new superheavy elements.

References

[1] A. Nasirov, A. Fukushima, Y. Toyoshima, Y. Aritomo, A.Muminov, S. Kalandarov, and R. Utamuratov, Nucl. Phys. A 759, 342 (2005).
[2] A. K. Nasirov, A. R. Yusupov, B. M. Kayumov, Phys. Rev. C 110, 014618 (2024).
[3] J. M. Gates, R. Orford, D. Rudolph, et al., Phys. Rev. Lett. 133, 172502 (2024).
[4] A. Nasirov, B. Kayumov, Phys. Rev. C 109, 024613 (2024).

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