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Theoretical investigation of the production of superheavy nuclei near neutron closed and deformed shell regions

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The existence of the island of stability has been predicted [1]. One of the major topics in nuclear physics is the production of $^{298}\mathrm{Fl}$, which is located at the center of this island.
A previous study [2] predicted that synthesizing a compound nucleus more neutron-rich than $^{298}\mathrm{Fl}$ (e.g. $^{304}\mathrm{Fl}$) may offer an advantage in terms of production probability. Firstly, due to its lower neutron binding energy, neutrons can be more easily evaporated. Furthermore, neutron emission brings the nucleus closer to the predicted neutron shell closure at $N = 184$, which increases the shell correction energy. These effects help to prevent a significant decrease in survival probability at high excitation energies.
In this study, these mechanisms are theoretically investigated using experimentally studied reaction systems. Particular attention is paid to $^{278}\mathrm{Ds}$ and $^{280}\mathrm{Ds}$ ($Z = 110$), formed via the $^{40}\mathrm{Ar} +^{238}\mathrm{U}$ and $^{48}\mathrm{Ca} +^{232}\mathrm{Th}$ reactions [3], respectively, near the deformed shell region at $N = 162$. We also discuss the synthesis of new elements in which these mechanisms may be confirmed.
We calculated the entire fusion-fission process in the superheavy region in three stages: (i) the projectile-target contact, (ii) the competition between fusion and quasi-fission, and (iii) the decay of the excited compound nucleus. We employed the coupled-channel method [4, 5] for stage (i), the multidimensional Langevin approach [5] for stage (ii), and the statistical model [6] for stage (iii).
In this presentation, we primarily discuss the effect of neutron evaporation and the resulting increase in the shell correction energy. This effect plays a crucial role in the survival probability of the compound nucleus. It may also play an important role in reaching the island of stability.

References

[1] W. D. Myers and W. J. Swiatecki, Nucl. Phys. 81, 1 (1966).
[2] Y. Aritomo, Phys. Rev. C 75, 024602 (2007).
[3] Yu. Ts. Oganessian, et al., Phys. Rev. C 109, 054307 (2024).
[4] K. Hagino, et al., Computer Physics Communications 123 (1999) 143–152.
[5] Y. Aritomo, et al., Phys. Rev. C 85, 044614 (2012).
[6] M. Ohta, Proceedings of Fusion Dynamics at the Extremes, pp. 110-122 (2001).

Research field of your presentation

Theoretical Low-energy nuclear physics

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