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Possibility of Synthesizing New Superheavy Elements using ^{51}V, ^{54}Cr Projectiles/^{51}V, ^{54}Cr 入射核を用いた新超重元素の合成可能性

Thursday, 14 November 2024 16:00 (2 hours)

In recent years, the synthesis of new superheavy element(SHE) as been paid attention around the world. When synthesizing SHEs, hot fusion using ^{48}Ca as projectile and actinides as targets is successful for many SHEs up to Og (Z=118) [1,2]. In synthesizing SHEs after Z=119 by hot fusion, if ^{48}Ca is used as projectile, it is necessary to use nuclides after Es (Z=99) as targets. However, nuclides after Es (Z=99) have so short half-lives, it is not practical to use them as targets. Therefore, to synthesize SHEs after Z=119, it is necessary to use projectile with a higher number of protons than ^{48}Ca. This allows the target to be determined relatively stable nuclide in actinides.The synthesizing of SHEs includes touching process, formation process, and decay process. We calculate evaporation residue cross section by combining three probabilities of these processes. The touching probability is calculated by coupled channel model [3,4]. The formation probability of compound nucleus is calculated by dynamical model with Langevin equation [3]. And the survival probability of excited compound nucleus is calculated by statistical model [5]. In this study, we calculated the evaporation residue cross sections using ^{51}V and ^{54}Cr, which have more protons than ^{48}Ca, as projectiles and actinides as targets. And we analyzed the effect of difference in combination of projectiles and targets on cross sections.
In this presentation, we mainly discuss the effect of Q-value, that depends on the mass tables, on rising positions of cross sections'excitation functions and the associated difference in evaporation residue cross sections.

[1] Yu. Ts. Oganessian, et al., "Measurements of cross sections and decay properties of the isotopes of elements 112, 114, and 116 produced in the fusion reactions ^{233,238}U, ^{242}Pu, and ^{248}Cm+^{48}Ca", Phys. Rev. C 70, 064609 (2004).
[2] Yu. Ts. Oganessian, et al., "Synthesis of the isotopes of elements 118 and 116 in the ^{249}Cf and ^{245}Cm+^{48}Ca fusion reactions", Phys. Rev. C 74, 044602 (2006).
[3] Y. Aritomo, et al., "Dynamical approach to heavy-ion induced fission using actinide target nuclei at energies around the Coulomb barrier", Phys. Rev. C 85, 044614 (2012).
[4] K. Hagino, et al., "A program for coupled-channel calculations with all order couplings for heavy-ion fusion reactions", Computer Physics Communications 123 (1999) 143-152.
[5] Y. Aritomo, et al., "Fluctuation-dissipation model for synthesis of superheavy elements", Phys. Rev. C 59, 769, February 1999.

Primary author: KAWAI/川井, Kosuke/幸亮 (Kindai University/近畿大学)

Co-author: ARITOMO/有友, Yoshihiro/嘉浩 (Kindai University/近畿大学)

Presenter: KAWAI/川井, Kosuke/幸亮 (Kindai University/近畿大学)

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