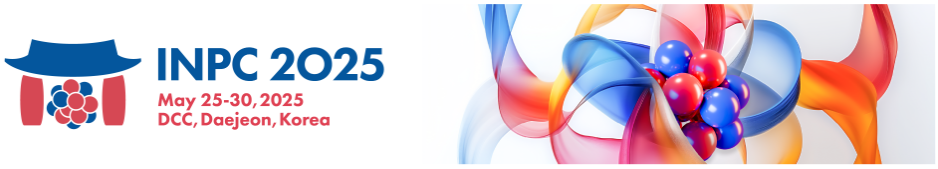

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Investigation of non-fusion reaction products in the $^{51}V + ^{248}Cm \longrightarrow ^{299}119^*$ fusion-evaporation reaction

Tuesday, 27 May 2025 11:00 (15 minutes)

The extremely low production cross-sections involved in the search for new elements and isotopes at the edges of the nuclear chart require highly optimized experimental setups and conditions. A thorough understanding of the data collected is essential to exclude potential contamination from other reaction products in the detection system.
The ongoing search for element Z = 119 is conducted at the RIKEN Nishina Center using the $^{51}V + ^{248}Cm \longrightarrow ^{299}119^*$ fusion-evaporation reaction at the SRILAC/GARIS-III facility [1,2]. During this search, many parasitic reaction products are also transported into the decay station of the GARIS-III setup. These products generate decay signals characterized by a wide range of decay times and energies, some of which overlap with the expected region of interest for the Z = 119 decay chain.
These reaction products predominantly arise from quasi-fission and fusion-fission processes during the fusion-evaporation reaction. They exhibit an isotropic distribution northeast of ^{208}Pb, with an average mass A = 219–220, and their decay times span from nanoseconds to days. Those events were identified using both electronic systems currently implemented in the GARIS-III setup: the Mesytec-based Analog DAQ and the Pixie-16 digital electronics [3]. This study presents the methodologies and efficiencies of these data acquisition systems in identifying fast-decay events.
The measured isotropic distribution has similar characteristics to previous studies of hot fusion reaction with actinide targets [4]. However, thanks to the addition of the fast and efficient digital electronics and the higher total dose, this distribution is also slightly wider. Direct identification of isotopes at N = 128 as well as some protactinium isotopes were made possible. Additionally, the implantation profiles measured in this study show significantly different characteristics than the previous studies [4], both in terms of the energy spectrum and profile/transportation.
Consequently, the accurate identification of all these reaction products within the detection setup was crucial to ensure uncontaminated and precise search. In addition, the digital electronics analysis allows to reduce significantly the signal in the region of interest for the search of new element Z = 119. This reduction arises from the waveform analysis and the pile up detection that the Pixie-16 board offers [3].

References

[1] D. Kaji, et al. “Gas-filled recoil ion separator garis-II”. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 317:311-314, 2013.
[2] Sakai, H., Haba, H., Morimoto, K. Sakamoto, N., “Facility upgrade for superheavy-element research at RIKEN”. The European Physical Journal A. 58, 238 (2022).
[3] Brionnet, Pierre, et al. “Development of digital electronics for the search of SHE nuclei using GARIS-II/III at RIKEN.”Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 1049 (2023): 168068.
[4] A. Di Nitto et al., “Study of non-fusion products in the Ti50+Cf249 reaction”, Physics Letters B 784, 199 (2018).

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