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On-line separators for the Dubna Superheavy Element Factory

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Production cross sections of superheavy elements (SHE) with Z = 112 ÷ 118 in fusion reactions are in the range of a few picobarns or less. To get access to heavier nuclides and carry out a detailed study on their properties, a sufficient increase in the beam intensity and the development of separators providing the necessary background suppression are needed. This is the main goal of the construction at the JINR's Flerov Laboratory of a first-ever SHE factory based on the high-current heavy-ion cyclotron DC280, having an experimental hall of 1000 m2 designed in compliance with class II radiation safety requirements for work with high active targets made of transuranium isotopes.

By choosing the separation principle, we have analyzed cinematic characteristics of different products for several hundred reactions leading to the formation of heavy nuclei. Unfortunately, the use of only magnetic fields is inapplicable for fusion reactions. Thus, electrostatic separators (energy selectors), velocity filters, and gas-filled systems were considered. Further analysis showed that it is reasonable to construct 3 separators optimized for specific tasks:

I. The universal gas-filled separator for the synthesis and study of properties of heavy isotopes and the investigation of reaction mechanisms. The ion-optical layout QDQQD is chosen for this set-up. The R&D and technical design were conducted, and the parameters of magnetic elements were determined. The negotiations with potential manufacturers are currently underway.

II. The velocity filter is chosen for a detailed spectroscopic study of heavy isotopes. This separator, named SHELS, is manufactured, equipped and installed for testing and use at the beam of the U400 cyclotron. Upon the completion of the construction of the SHE factory, it will be moved into a new experimental hall. (See special report to this conference).

III. To study radiochemical properties of SHE, extremely high suppression factors are not needed. One needs to work with thick targets at high beam intensities. Thus, we consider different versions of a simplified gas-filled QDQ system, gas-filled solenoid or multipole magnets. Coupled with a reaction product collection (RPC) chamber or a gas catcher, this set-up will serve as a pre-separator for further chemical separation and precise mass measurements, respectively.

Primary author: Dr POPEKO, Andrey (Flerov laboratory of nuclear reactions, JINR, DUBNA, Russia)

Presenter: Dr POPEKO, Andrey (Flerov laboratory of nuclear reactions, JINR, DUBNA, Russia)

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