Gamma and electron spectroscopy of transfermium isotopes at Dubna: results and plans

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Important information on the structure of Super Heavy Elements (SHE) can come from the study of lighter deformed transfermium (Z ~ 100-106) elements. The cross-section for the formation of these nuclei is many orders of magnitude higher than for $Z \geq 110$ so that detailed spectroscopy becomes possible.

The advantage of Dubna is the unique possibility to use radioactive actinide targets, which yield higher production cross-sections for heavy elements. The use of actinide targets also makes Dubna a complementary site for heavy-element spectroscopy because, until the availability of intense radioactive beams, it is the only way to produce less neutron deficient heavy isotopes. The opportunity to have high intensity (> 1 pμA) accelerated beams with $A \leq 48$ together with the use of exotic targets provide the possibility to study many aspects of heavy ion induced reactions exploiting new generation of high efficiency, high resolution experimental setups. The scientific fields of the application of the new setup could be concentrated on the study of asymmetric combinations leading to excited heavy compound nuclei.

Within the past 15 years, the recoil separator VASSILISSA [1] has been used for the investigations of evaporation residues (ERs) produced in heavy ion induced complete fusion reactions. In the course of the experimental work a bulk of data on ERs formation cross sections, synthesized in asymmetric reactions was collected [2].

In the years 2004 – 2009 using the GABRIELA (**G**amma **A**lpha **B**eta **R**ecoil **I**nvetsigations with the **EL**ectromagnetic **A**nalyser) set-up [3] the experiments aimed to the gamma and electron spectroscopy of the transfermium isotopes, formed at the complete fusion reactions with accelerated heavy ions were performed. Isotopes of No and Lr, synthesized at the $^{48}Ca + ^{207,208}Pb \rightarrow ^{255,256}No^*$, $^{48}Ca + ^{209}Bi \rightarrow ^{257}Lr^*$, $^{22}Ne + ^{238}U \rightarrow ^{260}No^*$ reactions were studied. The experiments with high intensity ^{22}Ne beam showed, that for slow evaporation residues rather high (~ 5%) transmission efficiency could be obtained. In this case for $\alpha - \gamma$ and $\alpha - \beta$ coincidences used in the study of the isotopes of 104 and 105 elements good statistics could be obtained during one month of the experiment.

In the close future it is planned to study neutron rich isotopes of the Rf and Db in the reactions $^{22}Ne + ^{242}Pu \rightarrow ^{264}Rf^*$, $^{22}Ne + ^{243}Am \rightarrow ^{265}Db^*$,

Accumulated experience allowed us to perform ion optical calculations and to design the new experimental set up, which will collect the base and best parameters of the existing separators and complex detector systems used at the focal planes of these installations.

References

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