Studying collective effects in neutron-rich isotopes with Z <38

Doctoral thesis summary

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The purpose of this dissertation was to investigate the properties of atomic nuclei in the area of 86<A<92 with the number of protons Z<38. In particular, we looked for the collective effects in rubidium, krypton, selenium and bromine neutron-rich nuclei.

In our study we used the most modern experimental techniques of nuclear spectroscopy. Among other things it was of prime importance to use the multidetector arrays of high energy resolution and high gamma registration efficiency. They allowed us to identify poorly populated excited states of the investigated nuclei and their decay patterns. We were collecting experimental data using *EUROGAM II* multidetector array in Strasbourg (France) and *GAMMASPHERE* spectrometer in Argonne (USA). With these two systems γ radiation emitted by spontaneous fission products of ^{248}Cm and ^{252}Cf was measured. Complementary to these experiments we performed a measurement of fission products induced by cold neutrons of ^{235}U which allowed us to excite the nuclei rarely populated in the spontaneous fission processes. Emitted γ radiation was measured with multidetector *EXILL* spectrometer in the Laue-Langevin Institute in Grenoble (France). To get a more detailed picture of the studied region we broadened our analysis with the excited states populated in β decays. For this purpose we used *MCC30* cyclotrone with *IGISOL-4* mass separator, *JYLTRAP* ion trap (Finland) and a multidetector γ and β radiation spectrometer built by the Warsaw Spectroscopy Group. This research enabled us to identify many new excited states of neutron-rich nuclei near the edge of the nuclei chart that was very poorly investigated thus far and to assign some particular values of the parameters describing their features. In particular, we established energy schemes of ^{87,88,89}Br, ^{90}Rb, ^{88}Kr and ^{86,87}Se. Morover, we supplemented the experimental data by the large-scale shell-model calculations using *ANTOINE* and *NATHAN* codes.

Very significant result of our analysis is the observation of collective effects that strengthen with decreasing number of protons in the nuclei with N=53. The pattern of the excited states in the investigated isotones with N=53 (^{87}Se, ^{88}Br i ^{90}Rb) and three neutrons outside the closed core N=50 is typical for j^3 multiplet and demonstrates "j-1 anomaly" characteristic for the deformed nuclei. We observed the strongest collective effects in ^{87}Se isotope for which the intensity of γ transition is equal to B(E2:5/2+→3/2+)=32 W.u., while the deformation parameter is close to β_2~0.2.

During the process of data analysis we developed some software tools that can be applied also in different studies in nuclear physics.