ULISS project

Recently the new universal laser ionization spectroscopy system (ULISS) has been established in the IRIS experimental hall. This system aimed at selective production and spectroscopic investigations of neutron deficient and neutron rich nuclei far from beta-stability line. Using of the new laser system makes wider the range of the objects under study and makes a considerable progress toward the proton and neutron stability boarder.

One of the most interesting objects for this laser-nuclear spectroscopy is an investigation of the so-called shell effect in the mean square charge radii, i.e. the marked kink in the isotopic mean square charge radius dependence at the magic number. Disappearance of this kink may point to the change of the magic number. The magic numbers change (or conservation) far from beta-stability line is the one of the most pressing problem of nuclear physics. In this respect the most interesting objects for investigations on the ULISS installation are Sb, Sn, In, Cd, Ag with neutron number N close to N=82.

There is no enough information about the shell effect in the region near N=50. Here the most interesting isotope chains are the chains of Ge, Ga, Zn, Cu, and Ni isotopes. These isotopes attract additional interest as unique objects to test the mean square charge radius trend between the two neighbors closed sub-shells.

Another area of interest of the ULISS is a vicinity of N=126. The three orders of magnitude drop of the half-life values takes place for the isotopes of Ac, Ra, Fr, Rn, and At at the N=126, for example: $T_{1/2}(Rn^{212})$=24 min, $T_{1/2}(Rn^{213})$=20 ms). This leads to a fast drop of the production rates of the very short-lived nuclei and the usual laser-nuclear spectroscopy method cannot be applied because of lack of sensitivity. Making the production efficiency of such nuclides higher using ULISS installation we can get a chance to investigate this very interesting area of the anomalous short life times.

The Hg isotope chain takes a very special place for the ULISS scientific program. Investigations of these isotopes started the laser-nuclear direction in nuclear physics. Here the well known “jump” in the course of mean square charge radii and the “staggering effect” (unusually wide fluctuations of mean square charge radii at the transition from even to odd isotopes) were found. It would be very interesting to find whether the stabilization of this staggering effect takes place and, if yes, at which N it happens. For this purpose the investigations of the isotopes with N<181 are necessary and possible due to high ULISS efficiency.