IRIN (Investigation of Radioactive Isotopes with Neutrons) project

In 2009 development of the ISOL installation on the thermal neutron beam of reactor PIK has been started. Such a system could provide an efficient isotope high intensity ion beam production for nuclear and laser spectroscopy and for nuclear medicine purposes. Indeed, the target made of uranium (^{235}U) carbide of 4 grams weight, placed at neutron beam of $3x\ 10^{13}\ n/cm^2$ sec, could provide the intensity of ^{132}Sn ion beam of about 10^{10} at/sec. This value of several orders of magnitude exceeds the possibility of IRIS facility at PNPI synchrocyclotron.

Preliminary program of nuclear physics investigations for the IRIN mass-separator:

1. Nuclear spectroscopy.

a. The nuclear characteristics of the nuclei very far from stability (time of life, decay modes and their branchings etc.) are of great importance for the models of astrophysical processes.

b. The problem of “the magic numbers conservation” for the far from stability nuclides has the fundamental value for nuclear physics and astrophysics.

c. There is a number of interesting problems when the source of pure isomer could give an excellent opportunity for new investigations (isomer-selective measurements of beta-strength functions etc.). To this end the isomer selectivity is very important point.

2. Laser spectroscopy. Isotope shift and hyperfine splitting measurements.

As mentioned above, the most interesting objects for systematic studies are nuclei with neutron number N close to N=82. These are neutron rich isotopes of Sb, Sn, In, Cd and Ag. There is not 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. Due to the considerable yield increase of neutron rich isotopes of these elements, the laser spectroscopy studies close to the edge of neutron stability could be very successful.

IRIN installation is supposed to be used for the high intensity ion beam production for medical purposes. Such isotopes as ^{131}I, ^{90}Y, ^{153}Sm etc with half-lives from several hours to several weeks can be applied for diagnostics and treatment of different diseases and for further investigations in nuclear medicine. For instance except the commonly used β^- - emitter for beta therapy ^{153}Sm, the other β^- - emitters (as ^{143}Pr, ^{149}Pm and ^{156}Eu) will be accessible. The production and application of isotopes with different half-lives make us possible to investigate relation between the half-life and the corresponding biological response.