The new project “ADSR” is aimed to determine the optimum beam-converter combination meant to optimize the efficiency of an accelerator driven subcritical reactor. The project proposal is the results of a detailed theoretical study focused on the conditions which maximize the energy gain of such system and ensure a safe exploitation. The main conclusions of the study are:

1. ADSR can represent an efficient source of energy, with energy gain G (defined as the electrical power produced in the plant to the power spent for the plant functioning) in the range 12-40.

2. ion beams starting with 7Li accelerated at energies below 1 AGeV realize higher G than 1-1.5 GeV proton beams.

3. the most interesting is a beam of 7Li with energy 0.2-0.25 AGeV that can produce the same net electrical power and higher G than 1-1.5 GeV proton beam with the same intensity. The replacement of 1.5 GeV proton with 0.25 AGeV 7Li allows to diminish the dimensions of the accelerator 2.5 times, with a corresponding reduction of the costs for building and maintenance.

4. an important role for the efficiency of ADSR plays the material used for the converter. Be is the best choice especially for ion beams at low energy. Its use increases the energy released by increasing the ion range. The properties of good neutron moderator and reflector allow the diminishing of the enrichment necessary to realize the needed criticality coefficient in a given geometry and improve the breeding capability of the reactor. In this way, longer cycles can be realized with deeper actinides burning. The effect depends on the dimensions of the Be converter, preferable being a converter with larger dimensions (radius 10-20 cm and length 100-120 cm).

5. in ADSR until 20-25% from the initial actinides mass can be fissioned in one cycle, in comparison with 6-7 % realized in a fast reactor.

The conclusions were obtained based on the results of the simulations realized with the code Geant4 for a reactor core cooled with LBE, at industrial scale. These interesting results are a good argument for the experimental research.

The planned research will be oriented in two directions. The first involves the comparative study of the fission distribution and the energy released in enriched fuel blanket, irradiated with proton beams with energy 0.2-2 GeV and ion beams with masses until 20Ne and energies in the interval 0.2 -1 AGeV. The second consists in measurements of the neutron yield from various converters, irradiated with proton and ion beams.

The accelerator “Nuclotron” at LHEP is suitable for such experiments, being one of few centers in the world capable to accelerate protons and ions in the energy range of interest.

The proposed graphite target “GAMMA4” with fuel rods inserted inside and a central hole for the placement of different converters allows a correct comparison between the number of fissions and the energy released realized with proton and ion beams. The use of a graphite block instead of Pb gives the possibility to diminish the necessary amount of fissile material due to the softer neutron spectrum. Such target is easier to manipulate (due to its lower weight) and cheaper.

The chosen length of the target (120 cm) offers the possibility to reproduce the dependence of the energy released on the dimensions of the Be converter for low energy ions.

On horizontal and vertical direction there are holes with radius 2 cm for the detectors. The distribution of fissions along the target, at various radii will be measured with samples of 238U and 235U, using the activation method. Besides the activation method, we plan to use small fission ionization chambers, also.