



Review of the JINR project

“Study of deep subcritical electronuclear systems and their applications for energy production and transmutation of spent nuclear fuel”

To understand precisely fundamental physics in deep subcritical electronuclear systems is of importance for future realization of such systems for energy production and transmutation purposes, etc. Inconsistency between the measured and calculated power amplification coefficient (C_{AP}) was pointed out in the previous experimental program with the TS QUINTA. It is a good approach to proceed to the TS BURAN program by making full use of the existing uranium assembly to solve the problem by reducing leakage neutrons from the assembly. To obtain nuclear parameters in the large uranium assembly TS BURAN, which is very unique in the world, will give us very important information for future improvement in physics models in particle transport calculation codes. Thus the reviewer thinks the proposed project is essential in terms of scientific value.

The project team has completed a series of experiments on the TS QUINTA. If most of the team members are continuously available for the next project, there is no problem in human resources. They must have enough techniques to obtain necessary experimental data in the scheduled period because they successfully complete the previous experiments on the TS QUINTA although detectors need to be modified to fit the TS BURAN. Whereas the reviewer cannot judge whether the project budget of 1.3 million USD is valid or not due to limited information given in the proposal, the amount seems to be reasonable for this scale of the experimental program.

Finally the reviewer recommends executing the proposal.

In addition, the followings are some detailed technical comments and recommendations on the project.

- ✓ Measurements of uranium fission reaction and creation/destruction of ^{239}Pu are planned. In addition it would be very valuable to measure fission reaction of minor actinides, that is, Np, Am and Cm, by using small fission chambers for example, in terms of nuclear transmutation technology development.
- ✓ Measurements of reactions of long-living isotopes composing RAW (LLFP) are planned. However transmutation of LLFP nuclides in fast neutron spectrum

fields such as the TS BURAN is not very effective. Higher priority should be given to actinides nuclides rather than LLFP nuclides.

- ✓ According to the proposal (P. 38) the neutron leakage from the TS BURAN is just 1/3 of that from the TS QUINTA although the sizes of the TSs are much different. Is it possible to reduce the neutron leakage from the TS BURAN by narrowing the beam hole of the steel case and/or that of the uranium assembly to make the experiment more attractive?
- ✓ Cobalt targets were used to obtain information on high-energy neutron spectra in the TS QUINTA. The reviewer recommends to use the $^{209}\text{Bi}(n, xn)^{210-x}\text{Bi}$ activation reactions, where $x = 4$ to about 10, because more precise information on the neutron spectra above 20 MeV can be obtained.
- ✓ It is a good idea to use three kinds of target material, Pb, Th and U, in the center of the TS BURAN. The reviewer does not know how much the targets will be activated by proton/deuteron beam bombardments on the targets, the activation level may be very high. In that case a careful procedure to replace the target has to be established in advance to secure safety operation of the target replacement.

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