

Referee Report on DANSS by H. Gutbrod:

To 1 a: Goals of the experiment

The goals are well described and the importance of the experiment in the international context is well documented.

- a) Improving statistics in neutrino oscillation studies
- b) Understanding the neutrino spectrum as function of reactor power and fuel composition
- c) Preparing for 5-18 meter range of detection
- d) Building better and smaller detectors

The group has most probably optimized their new detectors, but simulations would be convincing.

To 1b) What it adds to the international scenario

The DANSS has a unique situation in the World: it can be placed very close to the reactor core of KNPP and the distance can be varied between 10.7 and 12.7m.

On the other side, the group wants a detector with better resolution and less complexity. Presently the highly segmented DANSS consist of 2500 Scintillator strips arranged in a block of one cubic meter. Here the group opens up to the international scene. The proposed S³ detectors bring in participation from Czech Republic. The Neutrino4/Neutrino6 brings in participation from South Korea

To 2: Contribution of the JINR Group, its responsibilities:

The JINR DANSS Group contributed strongly to the hardware procurement for DANSS (development, production and purchases), the installation and the operation at the KNNP reactor site. (Some persons collaborate also in GEMMA-III and in Neutrino4, The same physicists, engineers, electronicians and technicians work in both projects. This is very reasonable in view of access to the reactor and proximity of experimental site.

But they are working also in other experiments like in

- EDELWEISS (the direct detection of Dark Matter particles by means of bolometric detectors located at the underground laboratory of Modane)

- NEMO ,
- TGV (Search for double beta decay of ^{106}Cd in the TGV-2 experiment),
- GERDA, The GERmanium Detector Array for the search of neutrinoless double beta decay in Ge-76 at the Laboratori Nazionali del Gran Sasso (LNGS)
- and some more

The DANSS group is sharing management-responsibilities with ITEP and in S-cube with the Prag team.

It should assure it's strong participation in the physics output from the DANSS. Participation in Neutrino4 and Neutrino6 is only recommended if the JINR group is burning to achieve physics goals of these projects. Doing logistic work is certainly necessary but not sufficient for participation in a high level experiment.

The spreading of the group into many projects needs to be looked at very closely. On one side the group members could benefit from participation in many international experiments, on the other they are no-where the full time leaders of the project. As stated few years ago in Dubna directorate, the participation of a JINR scientist should be limited to 2 or maximum 3 experiments, one in-house and one on foreign territory. The needed income should be assured.

The JINR Group has 15 persons, which is a very good size, 6 are full time in the experiment, out of which 3 are junior scientists who are doing dominantly 100% the analysis of DANSS data and the future S^3 data. 7 juniors in the group is a positive balance when looking into the future.

To 3 Group's plans for the future:

The group has reasonable ideas how to plan for the future.

- a) as application: Monitor the reactor with the DANSS spectrometer
- b) Continue searching for short –range oscillations with DANSS and with Neutrino4/Neutrino6 project.
I would like to see more precise time estimates for achieving this goal.
- c) Create two new neutrino detectors S^3 using better scintillator material wit up to 4 times higher light output, doubling the energy

resolution. They can be put from 5 to 18 m distance to the reactor core.

d) If possible taking more active part in upgrade of Neutrino4

The group indicates that it will want to take on more active part, i.e. more responsibility. ***This leads to the discussion, in how many experiments the team should be involved.*** Could it get more scientific results and better recognition if it would concentrate to those where it can have leadership and not only service?

To 4: Publications

The group has 2 publications of technical specs of DANSS and one Phys.Lett. B publication, presenting the first preliminary results.

To 5: PhD theses:

Two theses are in preparation and expected for completion in 2019.

To 6: Talks in 2017 and 2018

9 talks are given at conferences and workshops.

One invited talk at the NEUTRINO 2018 Conference at Heidelberg, and 8 parallel talks. ***This looks very reasonable in view of the delayed start of the data taking in 2016. I expect that the juniors will have - from now on- an even bigger chance to present the data.***

To 7a) Group size, composition and budget

For the chosen work and future plans, the group size of 15 looks to me reasonable. The 10 juniors is a refreshing value of this team. The 5 seniors with their 5% to 30% participation are hopefully not an obstacle in the ambition of the group, but on the contrary a help in their development. Members of the group participate also in other related experiments like GEMMA-III, which is a needed symbiosis due to reactor access regulations. The possibility of remote control of the experiment I assume has been studied.

To 7b: Expected changes in group size

No changes expected

To 7c: JINR group budget from 2018 till the end of the currently approved project in a table specifying the main budget items (equipment, computing, salaries, common funds, travel...)

The group has requested a budget for the next 3 years. This has been explained reasonably by the spokesperson to me. However, I think that

the demand for the 3d year is too small in view of the proposed participation in S³ and in Neutrino4/Neutrino6 in NIIAR.

The list does not contain the salaries or premiums.

In summary:

The project DANSS and the plans of the group in the future are worth being pursued. I would like to see more precise time estimates for achieving the physics goals.

In addition, the group should be supported and encouraged in their wish of taking more active part in state-of-the art experiments to build up leadership in their chosen neutrino physics experiments, while applying their world expertise of working very close to reactor cores.

This is especially important in the decision if and what the group should do in Neutrino4/Neutrino6 and where would be room for taking on leadership positions. The group proposes to build the muon veto system, which is of course needed. But Physics is in the liquid scintillators. So participating in Neutrino4/Neutrino6 must be compared with improving DANSS and S³ to its fullest. I recommend prudent evaluation and study of participation in other international experiments where some group members are already in.