Referee report on the Project NOvA (JINR participation)

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The report given to the Program Advisory Committee of JINR on 26 June 2017 outlines the proposal submitted by JINR neutrino physics researchers to continue their activities within the NOvA experiment in the USA.

Some of the most outstanding particle physics results obtained in the last two decades came from the study of neutrino oscillations, originally postulated by Bruno Pontecorvo. Experiments conducted with atmospheric and solar neutrinos, confirmed with man-made reactor and accelerator neutrinos, allowed us to build a coherent scenario pointing to neutrino mixing and oscillations, the first indication of physics beyond the Standard Model of particles and interactions.

NOvA is a neutrino oscillation experiment running in the USA along the NuMI neutrino beam from Fermilab. Two detectors (made of liquid scintillator calorimeters) are used, one at Ash River in Minnesota, 810 km from Fermilab, and another one only 1 km away from the neutrino production target. The science objectives of the experiment include two of the still outstanding goals of neutrino physics: the hierarchy of the neutrino mass eigenstates and the possible existence of a CP violating phase δ in the PMNS mixing matrix.

The experiment started data taking in 2014 and a series of important results were achieved. The detection of an electron neutrino appearance signal has allowed restricting the parameter space for a CP violating phase, while the measurement of muon neutrino disappearance permitted to measure the elements of the 23 sector of the PMNS matrix with high accuracy. In particular the maximal 23 mixing was excluded at the 3 sigma level.

The contributions from the JINR group in these years have been important and visible. Thanks to the installation of a Virtual Control Room (ROC-Dubna) for remote monitoring of the apparatus directly from JINR, the group has been able to substantially and economically contribute to the data taking. The contribution of the JINR GRID infrastructure has been instrumental for the experiment data analysis. The hardware contributions were complemented by studies on the R/O electronics, also performed thanks to a full test bench infrastructure in house.

On the physics data analysis side, JINR researchers have addressed several important subjects: the understanding of instrumental R/O problems (so-called flashes), the development of the Monte Carlo simulation code, electron neutrino analysis, the study of a possible Supernova

signal, the detection of cosmic-ray events, slow monopole detection, and a series of measurements exploiting the near detector at Fermilab. All those subjects will be continued in the next years and extended whenever possible.

As a final remark, the referee appreciates the way the report was written, specifically outlining the features relative to the JINR group contributions. The whole group is effectively committed to the NOvA project. The relatively young contingent includes 5 bachelor and master students and 8 PhD students being trained in a state-of-the-art, international project. This is a positive element in view of the future life of the experiment, still able to provide outstanding new results in the forthcoming years. As far as the financial requests are concerned, the referee is happy to see that, thanks to the JINR ROC, the amount of travel expenses has been reduced w.r.t. previous request.

In conclusion, considering the sound scientific project, the gathered and expected physics results and the visibility of the group, the referee warmly recommends without hesitation the continuation of the NOvA experiment for the JINR group.

Prof. Dr. Antonio Ereditato