

Referee report
on the project
“Hadron Physics in Experiment COMPASS”

COMPASS is a fixed-target experiment at the extracted beam of SPS at CERN. The goal of the experiment is study of the hadron structure and hadron spectroscopy using high intensity beams of pions and muons. In the JINR theme 02-0-1085-2017.2019 “Studies of the Nucleon and Hadron Structure at CERN” there exists already project “COMPASS-II”. The main physics tasks of the “COMPASS-II” are, in particular, analysis of inclusive and semi-inclusive processes in deep inelastic scattering of muons and hadrons off polarized targets, exploring of the nucleon structure in the Drell-Yan processes, study of new structure functions characterizing transverse quark distribution in polarized nucleons.

In the project under consideration “Hadron Physics in Experiment COMPASS”, submitted by the DLNP group, other directions of research are proposed together with intention to considerably improve the precision of some of already obtained COMPASS results.

One of the top-priority tasks of the project is precise measurement of the electric and magnetic polarizabilities of a pion and a kaon. Polarizabilities are fundamental characteristics of hadrons, and their experimental measurement in Primakoff reactions may test the predictions of various theoretical models in a low-energy region, first of all the chiral theory. Though first results on the pion polarizability have been already published by the COMPASS collaboration, their uncertainty is much higher than that provided by theoretical calculations. In the project, it is proposed to analyze a large volume of new available data, that would essentially decrease both statistical and systematic errors. Moreover, for the first time it is planned to measure polarizability of a kaon for which only rather loose estimation of the upper limit currently exists.

Of great interest are the planned in the project studies of exotic charmonia, the so-called XYZ states. Up to date tens of such states have been discovered but still there is no unambiguous interpretation of their nature. It is worth noting that investigation of exotic charmonia in COMPASS was initiated by the Dubna group. It is remarkable that the proposed in the project studies, including

leptoproduction of exotic charmonia, their production induced by pions, search for pentaquarks, can be done exclusively what is an undoubted advantage of the suggested approach.

One more planned task is study of the EMC effect, long time ago discovered but still not understood phenomenon of modification of the parton distributions in a nuclear medium.

In addition, the project authors are going to participate in development of the COMPASS physics program for the period beyond 2020.

The main content of the project consists in analysis of experimental data. Nevertheless, the project includes also the instrumental component related to upgrade of one of the detectors, Muon Wall. Participation in data taking is also in the list of actions.

In spite of the physics goals of the project partly overlap with the goals of already existing in JINR project "COMPASS-II", opening of a new one seems reasonable because it includes mainly distinct actual issues, and the project will be realized by a separate group of DLNP physicists.

The authors have a solid background in the project problematics: a number of publications by the COMPASS collaboration and by Dubna physicists separately, as well. Their paper on polarizability of a pion was awarded the first prize in JINR in 2015. This ensures that the goals of the project will be reached. The requested resources seem reasonable.

I recommend to approve the project with the first priority.

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