Referee Report

on the theme 03-2-1101-2010/2016

"Physics of Light Mesons"

The theme "Physics of Light Mesons" encircles a large variety of quite different experimental activities at a number of laboratories throughout the world, covering the field of light mesons and of polarization phenomena at intermediate energies. It includes the **projects COMET** (at J-PARC), **GDH&SPASCHARM** (at MAMI, ELSA, FAIR and Protvino), and **SPRING** (at COSY and GSI); furthermore the **experiments TRITON** (at JINR), **MEG-PEN** (at PSI), **PANIUC** (at JINR) and **MUON** (at several muon facilities).

This theme already had extensive reviews in the last (44^{th}) PAC meeting of June 23-24 2016, and a number of positive recommendations were given, but official extension of the theme was postponed to the present PAC meeting.

Because the new report from the team leader A. Kulikov is in most parts a repetition of the 2016 report – with the addition of some illustrations and progresses – I will only comment the new developments of the theme.

1) project GDH&SPASCHARM is a large collaborative effort in particle physics at proton accelerators in the medium energy (GeV) range. Significant progress in the study of nucleon spin structures was achieved thanks to the development, construction and maintenance of new spin-polarized targets by the Dubna Lab. Continuation of project GDH&SPASCHARM in 2017-19 is strongly recommended.

2) project SPRING aims also at spin physics, but using hadron storage rings It is recommended to continue SPRING for the years 2017-19 in the form of an experiment (analysis of ANKE) and development of the EDM search.

3) project COMET is a search for neutrinoless $\mu \rightarrow e$ conversion at JPARC. The Dubna group continues to play an important role in R&D of key components (thin straw tubes and testing LYSO crystals in a new facility at DLNP). The continuation of participation on COMET in the years 2017-2019 is strongly recommended.

4) experiment TRITON is the latest of JINR's long standing and famous experiments at the Dubna phasotron on muon catalyzed fusion in (H, D, T) isotopic mixtures. Two successful runs were performed 2016 in two different detector geometries, to clarify the reaction mechanism of the ptμ fusion process. The discovery of a new 4th reaction output channel pt$\mu \rightarrow$4Heμ + γ + γ + 19.82 MeV which has previously escaped observation was confirmed in the last run. It is strongly recommended to continue support of the (local) TRITON experiment in 2017-19.

5) experiment MEG-PEN consists of two large collaborations of fundamental experiments in muon science conducted at PSI. For PEN (rare pion decays) the final results are expected to be published in 2017. MEG (now upgraded to MEG-II) is a new experimental search at PSI for the rare muon deacay $\mu \rightarrow e+\gamma$ with the goal to improve the upper limit to a level of ~ 4 10-14. The continued participation on MEG-II in 2017-19 is strongly recommended.

6) experiment PAINUC is a study of π-4He nuclear interactions at very low energies performed at the Dubna phasotron using a special streamer chamber technique developed by Dubna scientists. New results of three-prong events from the reaction are presented. It is recommended to continue the analysis.

7) experiment MUON studies materials using the muon spin resonance method with negative muons. As recommended last year, the studies are interesting and deserve continuation.

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General conclusion:

All activities within the theme "Physics of Light Mesons" are of high scientific standard. Several programs and participations by Dubna scientists to international collaborations represent real frontier physics. Therefore my last year's conclusion is unchanged, and I strongly recommend that the theme "Physics of Light Mesons" should be continued with highest priority.

Some activities might be finished in 2017, but a number of important projects go much longer and need support much beyond 2017.

Villigen, January 16, 2017

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