Review

on the project report

"R&D for modernization of the photon spectrometer PHOS ALICE"

(JINR participation)

The ALICE Photon Spectrometer (PHOS) designed to detect and measure pulses of direct (thermal) photons generated in collisions of ultra-relativistic heavy ions at the LHC. These photons believed to carry information about quark-gluon matter, the study of which is the main goal of the ALICE project.

PHOS currently consists of 64x56 PbWO4 crystal modules, the number of which be increased during the planned shutdown of the LHC in 2013-2014. Therefore, PHOS should cover the aperture of 0.13 - 17.8 ° azimuth range. The elementary cell of the calorimeter is a PbWO4 crystal 18 cm long and provides 20 radiation lengths (Xo = 0.89 cm). The transverse dimensions of the crystals are 22x22 mm2 larger than the Moliere radius of lead tungstate Rm = 20 mm.

The existing PHOS readout electronics consists of a photodetector (APD), a charge-sensitive preamplifier (CSP), analog shaper with one fast trigger channel PHOS and two channels with x1 and x16 gain, optimized for maximum signal-to-noise ratio (S / N). In order to expand the 14-bit dynamic range in energy up to 80 GeV, the energy channels are digitized by two 10-bit ADCs of the ALTRO microcircuit, with a sampling frequency of 10 MHz. Readout of information is controlled by the Readout Controller Unit (RCU). The ALTRO and RCU microcircuit originally developed for the Time Projection Chamber (TPC), not quite optimal for the PHOS requirements, but chosen due to economic constraints.

Since the signal from a photon in central Pb-Pb collisions at the LHC is located relatively in the 1-10 GeV energy range, this makes the experiment difficult due to the presence of a significant background of secondary particles, both charged and neutral, in this energy range. In this part of the spectrum, the signal from is several percent of the background.

The separation of the photon signal from the background based on the following:

- identification of a charged particle by the ALICE tracking system;
- b) topological analysis of shower evolution in PHOS;
- c) time-of-flight measurements of the TOF subsystem.

The extraction of photons from neutrons and antineutrons is carried out based on b) and c) methods, and further improvement of the extraction of photons is possible only by measuring the flight time.

The PHOS electronics modernization program proposed by the JINR team takes into account:

- Increase in the energy range up to 100 - 200 GeV;
- Increase the speed of Pb-Pb interactions from 50 kHz to 2 MHz;
- Increase of the working temperature of the calorimeter up to 18.5 degrees Celsius;
- Increased temporal resolution up to 500 ps.

The proposed PHOS modernization project, in general, updates the strategy of the calorimeters in the central barrel of ALICE. The technical solutions put forward by the JINR team are new and timely.

During the implementation of the project, a new 32-channel FEC in the PHOS ALICE standard developed with the following main functions: two channels of information processing - amplitude and time, processing of an energy amplitude channel with two different gains, an accuracy of digitizing an energy channel - 14 bits, time measurements based on the latest customized picoTDC chip, a distributed high voltage power supply system of individual APD. Two prototypes manufactured.

Attention should be drawn to the importance of this work not only for the modernization plans of the ALICE collaboration, but also for the modernization of VBLHEP within the framework of the NICA megaproject, where the results of the work can be in demand

I consider it expedient to approve the report on the project "R&D for the modernization of the photon spectrometer PHOS ALICE" (JINR participation) for the stage in 2019-2020.

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