Project review

EXPERIMENT TECHNOLOGY DEVELOPMENT AND APPLIED RESEARCH WITH SLOW MONOCHROMATIC POSITRON BEAMS

Complex LEPTA (Low Energy Particle Toroidal Accumulator) was created at JINR for generation of directed monochromatic fluxes of positrons and positronium atoms to be used in fundamental experimental studies in particle physics. Currently, the programme of work on the project substantially expanded and complemented by applied research in the physics of solid matter, and engineering of materials and surfaces, using the method of positron annihilation spectroscopy (PAS) that is certainly interesting and practically important task. In this review, the reviewer focuses on this topic, which is of his professional interest.

Feature of the equipment created at the complex are the positron flux monochromaticity (spectral width (FWHM) at the exit of the positron injector is 2.3 eV) and the possibility of varying the energy of the positrons on the target. PAS in the "Doppler broadening annihilation line" variant (Doppler Broudening Annihilaction Line — DBAL) allows to study samples of various materials, including implanted ions from the cyclotron of the FLNR. In 2017 a digital the positron lifetime spectrometer was mounted that is of interest to study the radiation effects in different materials. Opportunities for research by the PAS method will be significantly expanded by creating at the specialized monochromatic positron channel (SMPC), and equipping the channel by apparature for forming an ordered flux of positrons (the method proposed by the group). This will allow one to study materials by measuring the lifetime of positrons in matter (Positron Annihilation Lifetime Spectroscopy — PALS).

For 2015 — 2016, the group significantly advanced the experiment conditions of the complex. SMPC was built and tested by a positron, equipped with experimental PAS station. Method PALS worked with positron source of low intensity that provides a wide energy spectrum. The transition to an ordered flux of positrons in SMPC will create unique experimental conditions. The group upgraded the cryogenic source of monochromatic positrons, which was modified to a closed cycle cooling with liquid helium from cryocooler. All this allows us to hope for the fulfillment of the tasks planned by the LEPTA group.

I propose to recommend the project to the prolongation, as it is of scientific and practical interest for JINR, Russia and JINR member-states.

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