

Project review

LEPTA PROJECT: EXPERIMENT TECHNOLOGY DEVELOPMENT AND APPLIED RESEARCH WITH SLOW MONOCHROMATIC POSITRON BEAMS

The project is realized on the positron injector of accelerating-storage complex LEPTA (Low Energy Particle Toroidal Accumulator), which was created as an facility for the generation of highly directional monochromatic fluxes of positrons and positronium atoms in order to conduct fundamental experimental studies on such flows. The project has held hearings on the STC DLNP and the PAC for nuclear physics. Program possible experiments developed at that time, is of considerable interest today. At the same time the possibility of using the injector of slow monochromatic positrons created in the complex, was understood for research in physics of solids using the method of positron annihilation spectroscopy (PAS). Such research was begun on the complex LEPTA in 2013.

Since mid-2011 the group focused on the development of the PAS.

Over the years:

- storage ring has been constructed and commissioned, the circulating electron beam has been obtained;
- cryogenic source of slow monochromatic positrons (CRIMP) with a narrow spectrum of positrons was created, the emitter of positrons based on the ^{22}Na isotope (manufacture of iThemba LABS, South Africa) provides a flux of slow positrons up to 10^6 s^{-1} with an average energy of 50 eV and a width of the spectrum (FWHM) of 2.3 eV;
- positron transport channels from the source to the trap from the trap in the ring has been constructed;
- an electron cooling system of positrons with stationary single turn electron beam has been created;
- experiments to optimize the accumulation of particles in the trap have been performed the explanation of the mechanism of compression of the beam in the trap under the action of the rotating electric field has been found (the second prize of JINR in experimental physics for 2015);
- the first turn of positrons over the ring accumulated in the trap has been implemented;
- PAS spectrometer has been created and several runs of PAS in the LEPTA injector have been performed;
- a new version of CrySSMP with a closed cooling cycle based on helium cryocooler has been designed;
- specialized transfer channel of positrons to the experimental station was designed and built.

The plan of further works on the LEPTA complex contains

- development of the method of positron annihilation spectroscopy (PAS) and research materials by this method, first of all the creation of the PAS version based on the measurement of the lifetime of positrons in matter;

— optimization of the positron accumulation process — the achievement of intensity of 10^7 positrons per cycle.

Overall, the project is original from the point of view of creation of new experimental equipment, and from the point of view of possible use. I consider it necessary to support the proposed project.

Chief engineer basic installation of the Nuclotron VBLHEP

Doctor of sciences

E. M. Syresin