INVESTIGATION OF POLARIZED MUON-PHOTON SHOWER IN CRYSTALS

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Modern accelerator technology and existing modern electronic and muon detectors allow investigating non-elastic electromagnetic interaction of high-energy electrons, muons and γ-quanta with atoms and nuclei of matter.

When high-energy charged particles (e±, μ±) and γ-quanta pass through matter, in addition to separate acts, they give birth to shower structures under certain conditions. These shower structures are continuously directed jets of various particles, such as, charged particles in solid and meters, electron (muon)-photon showers in amorphous and crystal environments, nucleon cascades in nuclear matter. Electromagnetic showers resulting from interactions of high energy particles with atom nuclei in crystal environment are main source of electron, positron and photon beams of high energy and also are excellent tool for investigation of matter structure and electromagnetic properties of nuclei.

This article deals with theoretical investigation of polarized electron-photon showers in crystals at two different initial conditions for emergence of shower: 1) shower is created by energy (E0) initial lepton (e±, μ±); 2) shower may also be created by initial high-energy γ-quantum (E0). We were there first who wrote down equations for the evolution of electromagnetic shower in crystals and found solutions to these equations under initial conditions indicated above. Analytical expressions that we obtained for the distribution of shower leptons and γ-quanta are

\[ P_{i,2}(t,E_0,E) = F_{i,2}(s,l,t) \exp(-1,(s)t) \]
\[ \Gamma_{i,2}(t,E_0,E) = \Phi_{i,2}(s,l,t) \exp(-1,(s)t) \]

Here s – is Laplas-Mellin parameter, E0, E – are initial and current energies of shower particles, t – is depth of penetration, F_{i,2}(s,l,t), Φ_{i,2}(s,l,t), l, and y - are some functions depending on s, initial energy of particles and initial conditions.

Detailed analysis of these functions for diamond crystal indicates that initial conditions make strong impact on both distribution function of shower particles and their polarization properties.