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Spin correlations of the final leptons in the high-energy two-photon processes $\gamma\gamma \to e^+e^-, \mu^+\mu^-, \tau^+\tau^-$

The theoretical study of spin structure for the processes
of lepton pair production by pairs of photons (which, in particular, may be emitted in relativistic heavy-ion and hadron-nucleus collisions) is performed. For the two-photon process $\gamma\gamma \to e^+e^-$, it is found that – in the case of unpolarized primary photons – the final electron and positron remain also unpolarized ,but their spins turn out to be strongly correlated. Explicit expressions for the components of the correlation tensor and for the relative fractions of singlet and triplet states of the final (e^+e^-) system are derived. It is established that in the process $\gamma\gamma \to e^+e^-$ one of the Bell-type incoherence inequalities for the correlation tensor components is always violated (i.e., there is always one case when the modulus of sum of two diagonal components exceeds unity), and, thus, spin correlations of the final electron and positron have the strongly pronounced quantum character.

Analogous consideration can be wholly applied also to the two-photon processes $\gamma\gamma \to \mu^+\mu^-$ and $\gamma\gamma \to \tau^+\tau^-$, which become possible at much higher energies.

Primary author: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

Co-author: Dr LYUBOSHITZ, Vladimir (JINR, Dubna)

Presenter: Dr LYUBOSHITZ, Valery (Joint Institute for Nuclear Research (Dubna))

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