Study of the $\eta \to e^+e^-\gamma$ Decay Using WASA-at-COSY Detector System*

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Since the η meson is a short-lived neutral particle, it is not possible to investigate its structure via classical methods of particle scattering. To learn about its quark wave function, one studies those decay processes of this meson in which a pair of photons is produced, where at least one of them is virtual. The virtual photons have a non-zero mass and convert into lepton-antilepton pairs. Therefore, information about the quarks' spatial distribution inside the meson can be extracted from the lepton-antilepton invariant mass distributions by comparing the empirical results with QED predictions, which are based on the assumption that the meson is a point-like particle. The deviation from the expected behavior in the leptonic mass spectrum exposes the inner structure of the meson. This deviation is characterized by a form factor.

The corresponding data were collected for the $pd \to {}^3He\,\eta$ reaction at a proton beam momentum of 1.69 GeV/c. The experiment was performed using the WASA-at-COSY detector in November 2008. 525 ± 26 events of the $\eta \to e^+e^-\gamma$ decay channel were reconstructed. The applied restrictions allowed to suppress the background from other η decays to a negligible level. Moreover, the multipion background was subtracted from the signal, based on missing mass distributions. The performed analysis enabled the extraction of the η transition form factor as a function of the e^+e^- mass and, therefore, the calculation of the slope parameter which is related to the charge radius of the η meson.

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