Dielectron Production in the $\eta \to \gamma e^+e^-$ Decay with WASA-at-COSY.

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The physics issues concerning the $\eta \to \gamma^*\gamma$ transision form factor is the main motivation of the ongoing analysis. One can study decays involving two photons from which at least one is virtual. Virtual photons convert into a lepton-antilepton pair. The square of the invariant mass of a created lepton-antilepton pair is equal to the square of the four-momentum of the virtual photon. Deviations from the QED expectation are due to the inner structure of the meson and can be characterized with the transition form factor

In October 2008 investigations of the η decays have been conducted using the WASA-at-COSY detector. The η meson has been produced in proton-deuteron collisions with a proton beam energy of 1.69 GeV. Based on the online analysis we expect that about 10^7 η mesons were produced. Currently, the detector calibration is carried out.

Here we report on the studies of the $\eta \to \gamma e^+e^-$ decay. Events of interest will be reconstructed using missing and invariant mass techniques. The identification of photons in the WASA calorimeter [1] is possible with $\frac{\sigma_E}{E} = \frac{5\%}{\sqrt{E}}$ resolution. In Fig. 1 one can see the polar angle distribution and Fig. 2 shows the kinetic energy for photons in the calorimeter. The picture comes from simulations of the $\eta \to \gamma e^+e^-$ decay and shows that 90% of the photons can be detected. The reconstruction of electrons and positrons is less efficient and optimization of existing algorithms has to be done in order to improve the number of identified particles. At present in order to estimate the number of expected $\eta \to \gamma e^+e^-$ decays, we assume that the acceptance and selection cuts will be the same as used in the analysis of the WASA/CELSIUS data [2]. Under this assumption the expected number of fully reconstructed $pd \to {}^3He\,\eta$ events with $\eta \to \gamma e^+e^-$ amounts to about 15000.

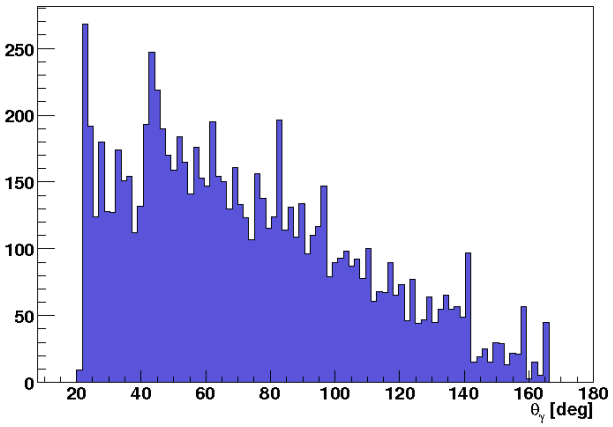

Fig. 1: Polar angle distribution of photons from the $pd \to {}^3He\,\eta \to {}^3He\gamma e^+e^-$ reaction. 90% out of 10^4 gammas produced, have been detected. Picture presents results of simulation without selection cuts.

For the discrimination between electrons and positrons, the dependence of the energy depositions in the Plastic Barrel detector on the momentum will be used. After the selection of events with γe^+e^- in the final state, the number of events coming from $pd \to {}^3He\,\eta \to {}^3He\gamma e^+e^-$ will be calculated using the missing mass technique for the $pd \to {}^3HeX$ reaction. Here, the momentum of the ^3He ions will be reconstructed based on energy losses in subsequent layers of the forward scintillators.

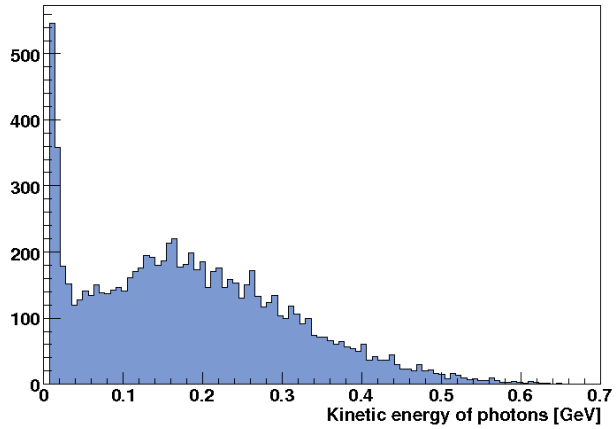

Fig. 2: Kinetic energy of photons from the $pd \to {}^3He\,\eta \to {}^3He\gamma e^+e^-$ reaction. Picture presents results of simulation without selection cuts.

The analysis of the data is in progress. The expected statistics should allow us to distinguish between expectations based on different models [3, 4].

References:

[1] see Fig. 1 in the contribution by C. Zheng.
[2] M. Berlowski et al., Phys. Rev. **D 77**, 032004 (2008).
[3] J. Stepaniak et al., Phys. Scr. **T99** 133-139, (2002).
[4] L. G. Landsberg, Physics Reports, **128** (6), p.301-376, Nov 1985.

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