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An analysis of the omega meson conversion decay using neural network-based technique with the CMD-3 experiment

The study of the conversion decay of the omega meson into $\pi^0 e^+ e^-$ state was performed with the CMD-3 detector at the VEPP-2000 electron-positron collider in Novosibirsk. The main physical background to the process under study is radiative decay $\omega \to \pi^0 \gamma$, where monochromatic photon converts on the material in front of the detector. The deep neural network was used to suppress these background events. The neural network was trained based on Monte Carlo simulation. The simulation is made with Geant4 library packages. To control the systematic error of this approach the events of the process of inelastic scattering $e^+e^- \to e^+e^-\gamma$ ($ee\gamma$) and events of annihilation into two photons ($\gamma\gamma$) were used as a similar to events under study. These processes are well calculated based on quantum electrodynamics. The difference in the calculated and measured ratio of the number of events $N_{ee\gamma}/N_{\gamma\gamma}$ was used as a systematic error. The performance of this approach was compared with the results of the gradient boosting framework xgboost. Using integrated luminosity about 10 pb^{-1} collected at the energy range from 760 MeV to 840 MeV we measured the visible cross-section of the process $\omega \to \pi^0 e^+ e^-$. The preliminary results for the branching ratio $Br(\omega \to \pi^0 e^+ e^-)$ were obtained. Usage of the neural network-based separation significantly decreases the contribution of radiation decay background events into the total systematic error.

Significance

A new neural network-based approach to separate the events of inner photon conversion and conversion on the material in front of the detector is presented. This approach can be relevant for any events with electron-positron pair production with a small spatial angle between tracks. The process to calculate the systematic error of this approach is proposed. This method is used to calculate the branching ratio and measure the visible cross-section of omega conversion decay at the CMD-3 experiment with high precision.

References

Speaker time zone

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