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Developing new routine for processing two-dimensional coincidence Doppler energy spectra.

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Coincidence Doppler broadening spectroscopy is a powerful technique to study the electron states in a wide range of materials and characterize defects.

Most of the current techniques implement background subtraction algorithms based on single-dimensional background fitting processes [1]. In current work we developed a new routine for two-dimensional background fitting of the Doppler spectra (Fig. 1). Subtraction of this two-dimensional fit provides a spectrum with more energy pairs related to the same positron-electron annihilation event. This results in improved calculations of the electron momentum distribution.

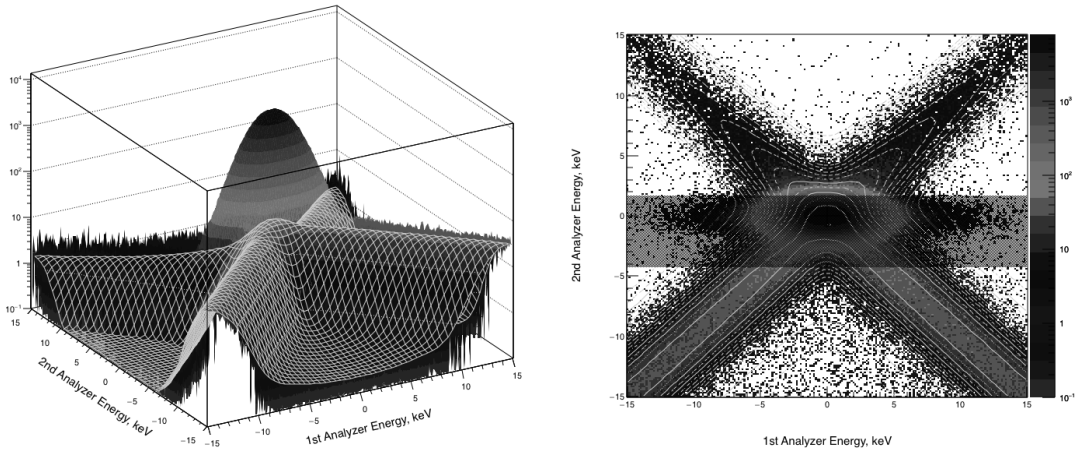

Fig. 1. Background fit of the two-dimensional annihilation energy spectrum of aluminum.

The shape of two-dimensional energy spectrum can be improved if we include contribution of three-gamma annihilation events in in the aforementioned background fit.

One-dimensional Doppler spectrum obtained from the 2D histogram should be stretched by the value of a square root of two. Additionally, when calculating S and W parameters from the two-detector Doppler spectrum the integration ranges should be multiplied by a value of two compared to single-detector experiment.

Setting the fitting function of the Doppler spectrum as a sum of parabola and Gaussian functions allows us to estimate the Fermi energy of the material under investigation.

[1] P. Pikart, C. Hugenschmidt, *Nucl. Instrum. Methods Phys. Res., Sect. A*, 750, 61–68 (2014)