

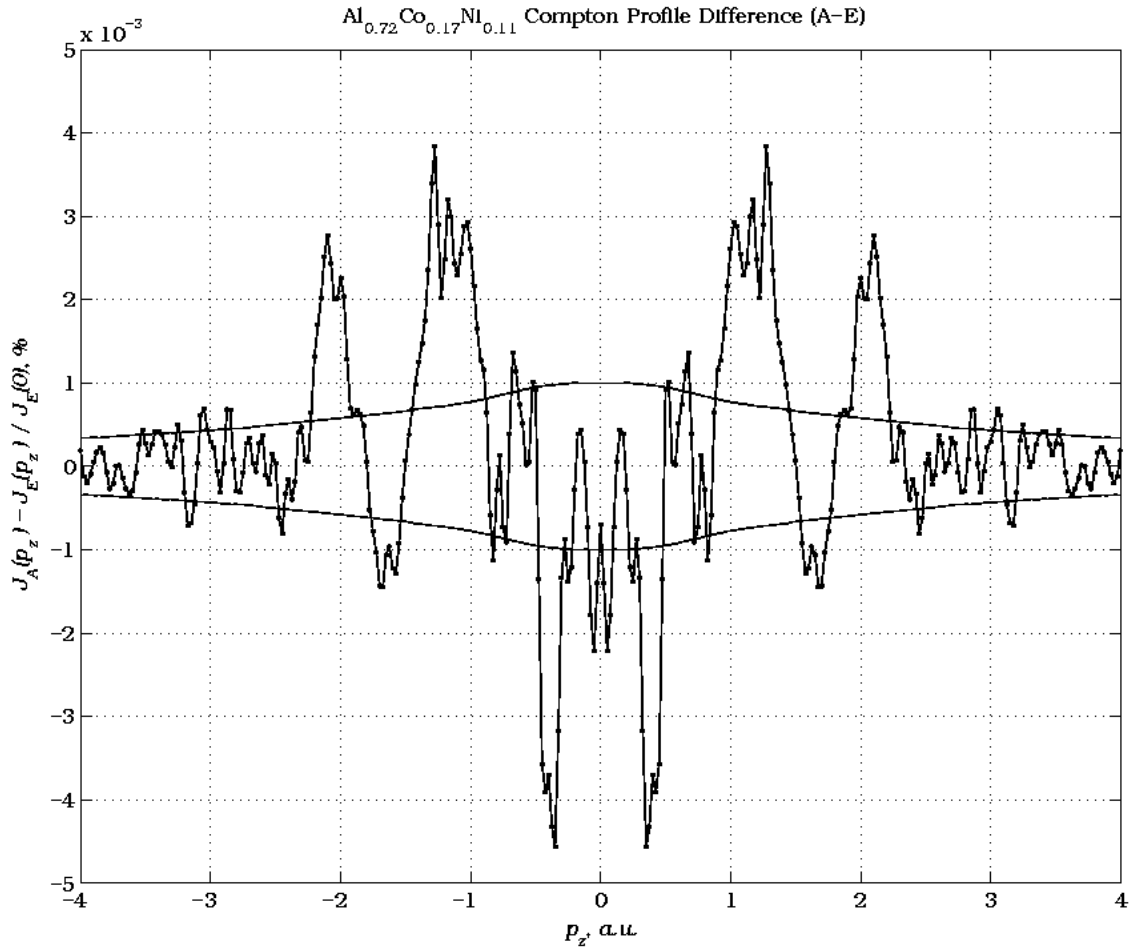


example, in semimetals. This suggests that it would be desirable to undertake experimental investigations of the Fermi surface in decagonal quasicrystals. Previous attempts using the de Haas--van Alphen effect in these materials were unsuccessful, most likely because the mean free path of charge carriers in these materials is rather short.

In order to gain a better understanding of the electronic structure of decagonal phases, we employed Compton scattering, a technique that is not sensitive to the mean free path of charge carriers. Here we report the results of measurements of the projection of the electron momentum distribution (EMD) along several crystallographic directions of a single-grain Al-Ni-Co decagonal quasicrystal. The flux-grown single-grain quasicrystal was cut and polished into a rectangular parallelepiped with dimensions  $x = 7$  mm,  $y = 1.5$  mm and  $z = 1.5$  mm, with  $x$  and  $y$  parallel to the 2-fold axes and  $z$  parallel to the decagonal axis. Radial scans showed a mosaic spread of only 0.14 degrees in the 2-fold direction, indicating a high quality sample. Using quantitative X-ray microanalysis, the composition was found to be 72 at.% Al, 17 at.% Co and 11 at.% Ni.

Compton profiles were measured in air with the scattering vector parallel to the 2-fold, 10-fold and four other crystallographic directions. In our experiment, the incident X-ray beam was 4.6 mm in height and 0.2 mm in width which allowed us to collect the Compton data with excellent statistics of better than 0.1 % at the Compton peak which lead to statistics in the anisotropy differences of about 0.1%. We applied corrections for air absorption and sample self-absorption, normalization to the incident beam monitor, efficiency of the analyzer and slit effects. The contribution from the core electrons was calculated using theoretical profiles corrected for the impulse approximation. In order to obtain the Compton profiles, we fit the tails of the Compton peak to the core profiles. Then, the spectrum was converted to the momentum scale, normalized to the electron number and symmetrized. Differences in the Compton profiles along different crystallographic directions were computed. In the figure below, we show the difference between the Compton profiles taken along the 2-fold and the 10-fold directions. The solid lines indicate the statistical uncertainty of our measurements. As a first observation, we note distinct features, much broader than the experimental resolution, indicative of strongly anisotropic Fermi surface, and we believe is the first observation of this phenomena.

Further refinement of our data will include corrections for multiple scattering. The complete data analysis will include modeling of the electronic structure of decagonal Al-Ni-Co and a detailed comparison between theoretically calculated and experimentally determined Compton profiles. We expect that our experimental results and analysis will lead to better understanding of the electronic structure of decagonal phases.



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