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ELECTRON MOMENTUM DENSITY OF HEXAGONAL MAGNESIUM STUDIED BY HIGH RESOLUTION COMPTON SCATTERING

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The significant role of valence electrons in matter is undisputed. Compton scattering, which provides information on momentum density distribution of free or weakly bound electrons, allows one to study subtle effects of electron interactions in various materials at momentum near Fermi surface. Especially valuable information is obtained when a high resolution Compton experiment can be carried out [1].

The directional Compton Profiles (CPs – one directional projections of electron momentum density distribution) of hcp single crystal of magnesium have thus been measured along [100], [110] and [001] directions using high energy (115.6 keV) synchrotron radiation and high-resolution (FWHM = 0.12 a.u.) Compton Cauchois-type X-ray spectrometer at SPring-8 (beamline BL08W) [2]. Subtraction of the profiles measured along two specific crystallographic directions removes the isotropic core-electron contributions and forms so-called difference profile, which shows the anisotropy of valence electron momentum density distribution in the material under study. The difference profiles become thus a source of valuable information about the behaviour of valence electrons.

The experimental data were compared with corresponding theoretical Korringa-Kohn-Rostoker (KKR) semirelativistic calculations and previous low-resolution (0.42 a.u.) Compton measurements, performed with the use of high-energy (662 keV) gamma ^{137}Cs source operating at the Faculty of Physics, University of Bialystok [3]. Both, the experimental and theoretical directional Compton profiles, show very small anisotropy of the electron momentum density in this hexagonal metal, at most half of the anisotropy observed typically in cubic systems. Our present data (Fig. 1) confirm presence of sharp fermiology-related features predicted by KKR theory. These features were smeared out and not observed in previous low-resolution measurements. We note, however, that the amplitude of the first peak at 0.25 a.u. is lower than KKR theory predicts. This may be probably due to correlation effects, not fully accounted in the theory.

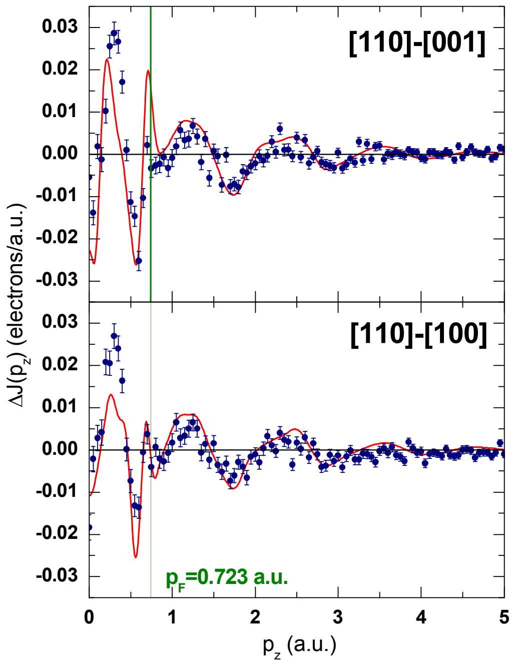

Figure 1. High resolution (FWHM = 0.12 a.u.) experimental (solid circles) and theoretical (solid lines) anisotropies of the directional Compton profiles of Mg. The vertical line shows the Fermi momentum 0.723 a.u.

References

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