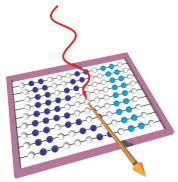
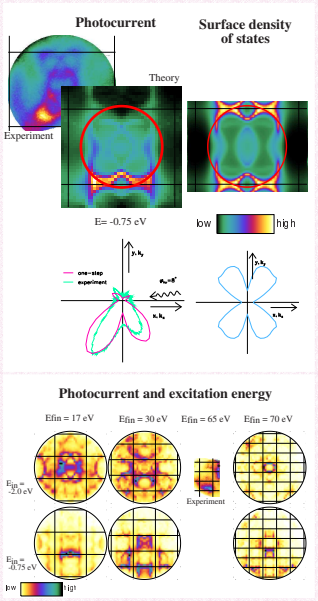


Analysis of Ultraviolet Photoelectron Angular Distributions from GaAs(110)

C. Solterbeck[1], W. Schattke[1], S. Hübner[2], R. Adelung[2], L. Kipp[2], M. Skibowski[2], C.S. Fadley[3], M.A. Van Hove[3]

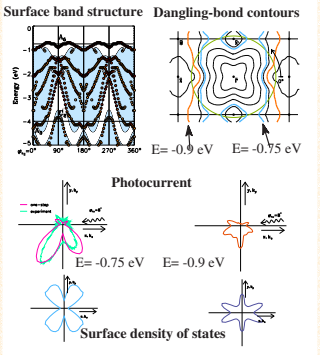
[1]Institut für Theoretische Physik und Astrophysik, CAU Kiel [2]Institut für Experimentelle und Angewandte Physik, CAU Kiel [3]Material Sciences Division, Lawrence Berkeley National Lab., Berkeley

More than Bands



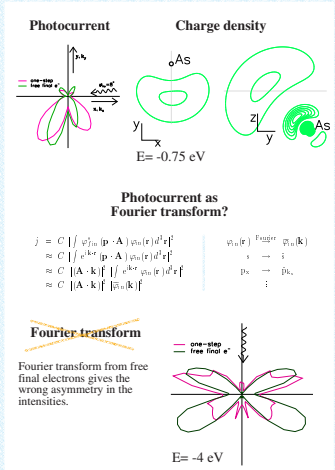
- The surface density of states shows possible positions of maxima in the photocurrent.
- They are strongly modulated by other influences.

Energetic Sensitivity



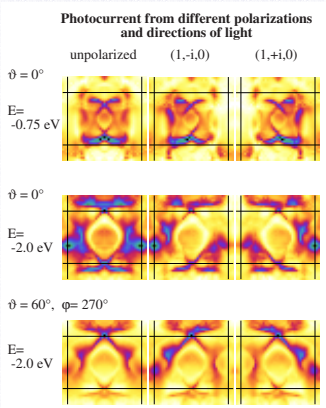
- The combination of energy distribution with angular scans allows for highly accurate band structure determinations.

Photocurrent and Charge Density



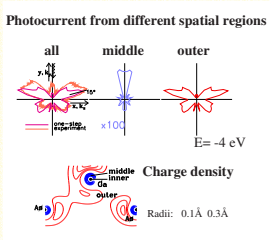
- Angular momentum and spatial density modulate the angular distribution of intensities.
- A trivial interpretation based only on the initial state is not possible.

Incident Light

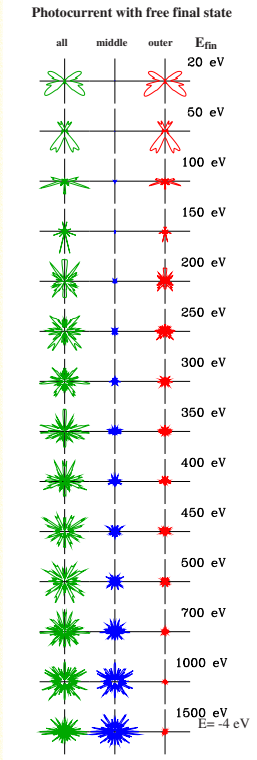


- Effects from polarization and direction of light can be very strong, even at non symmetry points where selection rules are not valid.

Spatial Sensitivity + Kinetic Energy

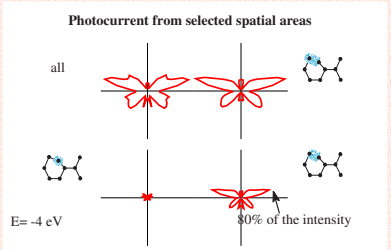


- ARUPS probes the bonding region.



- High kinetic energies cause an effective localization at the cores.

Local Emissivity in Extended States



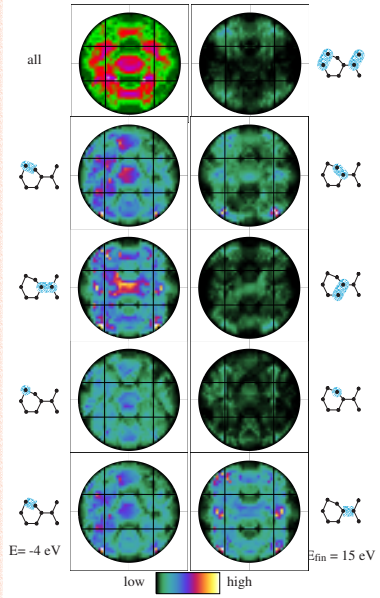
- The origin of photoelectrons can be traced into single bonds.
- The amplitude of the initial state appears as the local emissivity of the electrons to be scattered.

Interpretation:

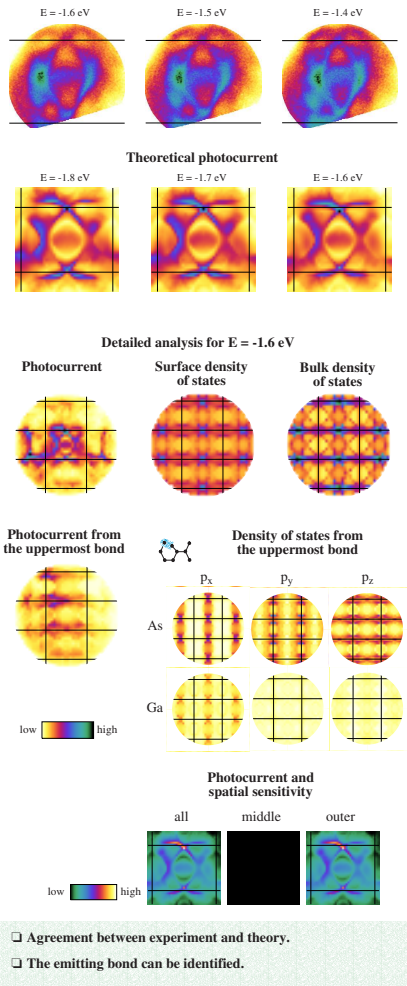
$$|\Psi\rangle = \sqrt{D}\, G(E_{fin}, \vartheta, \varphi)\, (\mathbf{A}\cdot\mathbf{p})\, |\Psi_{in}\rangle$$

$$j \propto |\int \varphi^*_{fin} (\mathbf{A}\cdot\mathbf{p}) \varphi_{in}(\mathbf{r})\, d^3\mathbf{r}|^2$$

Source



Decomposition



- Agreement between experiment and theory.
- The emitting bond can be identified.

C. Solterbeck, W. Schattke, J.-W. Zahlmann-Nowitzki, K.-U. Gawlik, L. Kipp, M. Skibowski, C. S. Fadley, M. A. Van Hove, Phys. Rev. Lett. **79**, 4681 (1997)

URL: http://www.tp.cau.de/schattke/