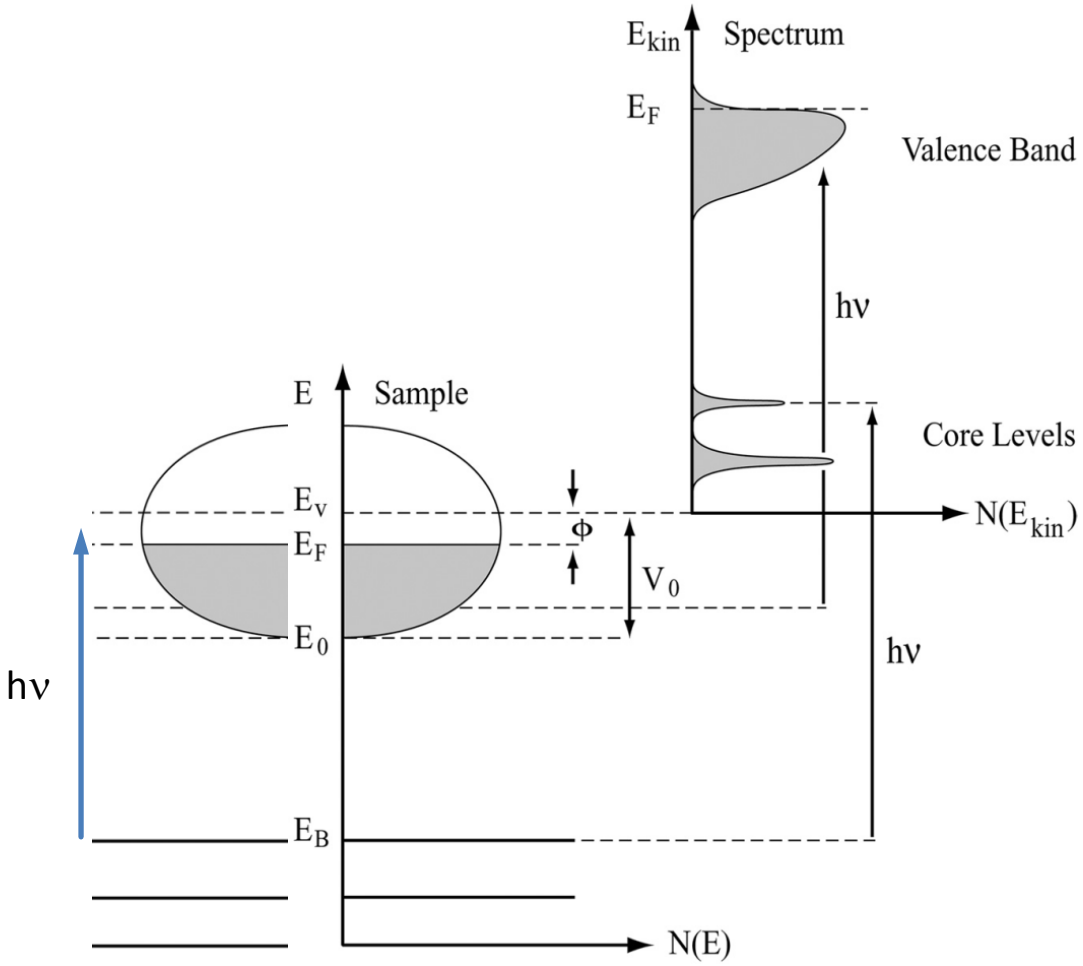
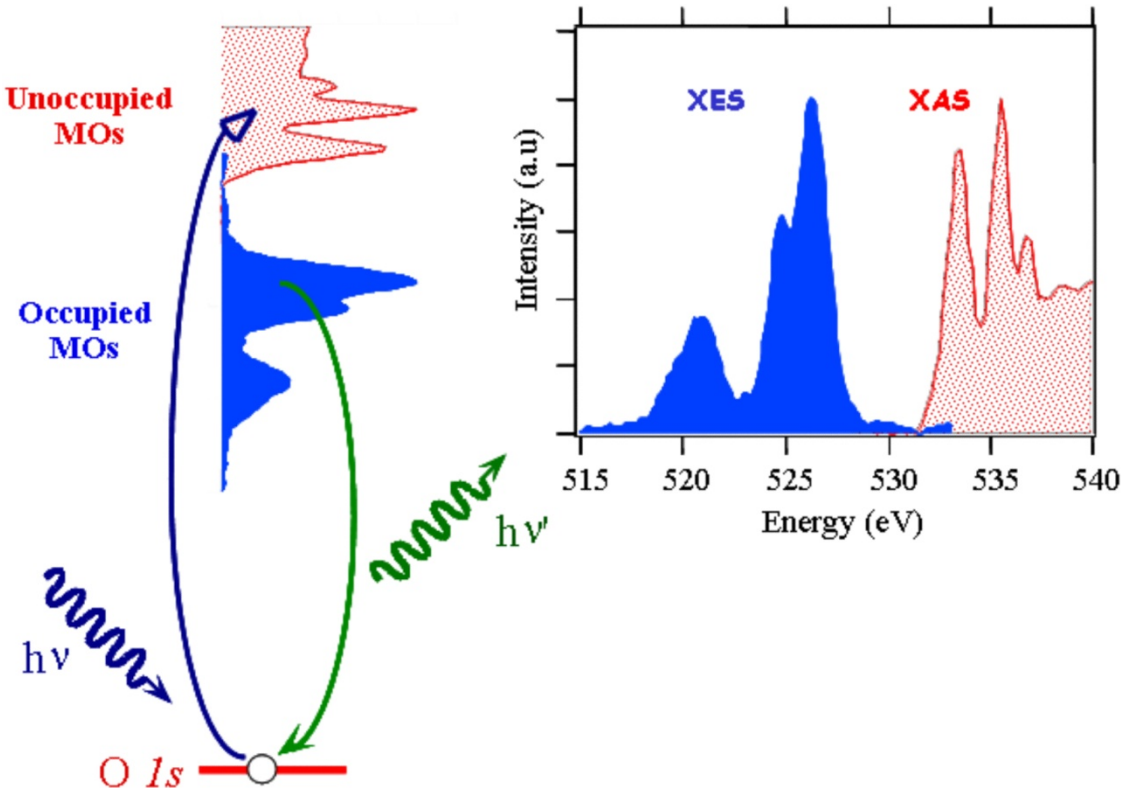
Optical & photoelectron spectroscopy



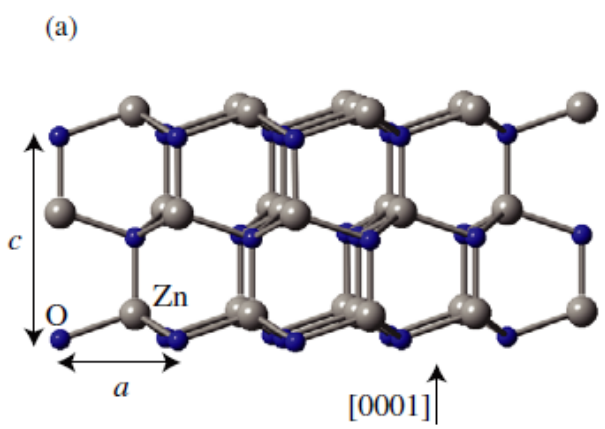
Damascelli, Physica Scripta (2004).

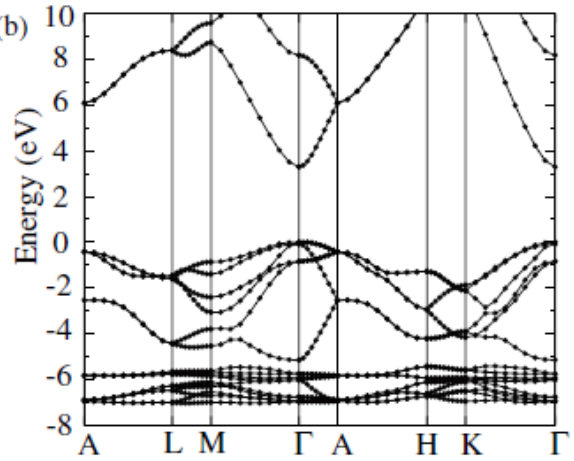
XAS & XES

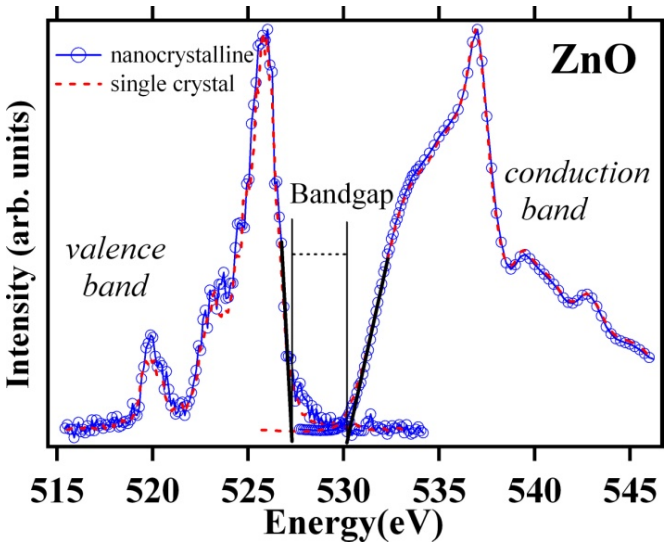


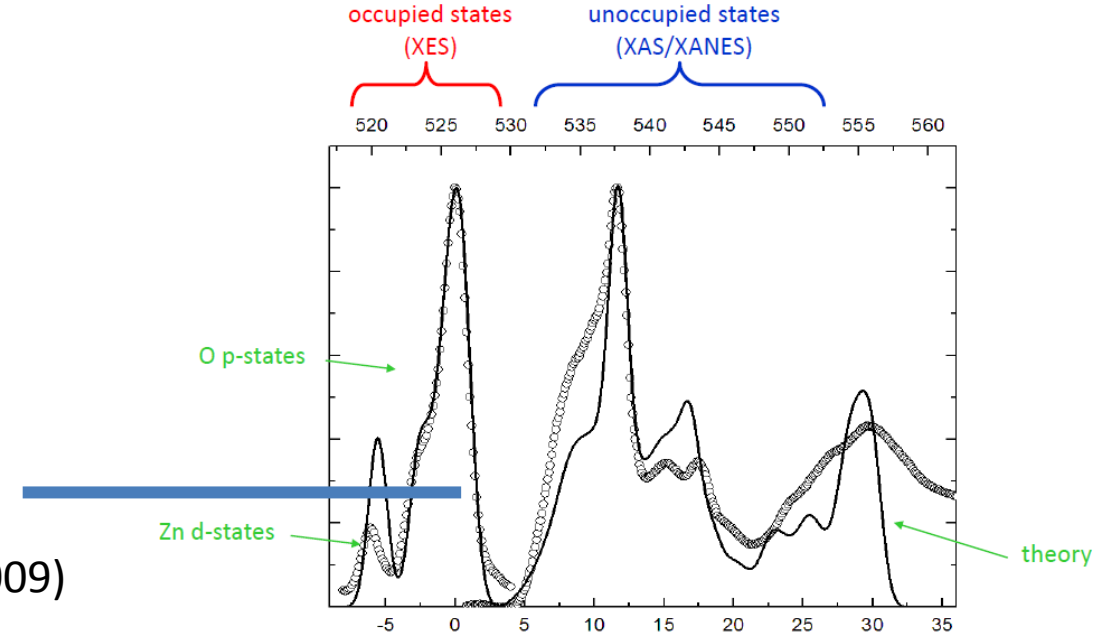
spie.org

Example ZnO









spie.org, Janotti, Rep. Prog. Phys. (2009)

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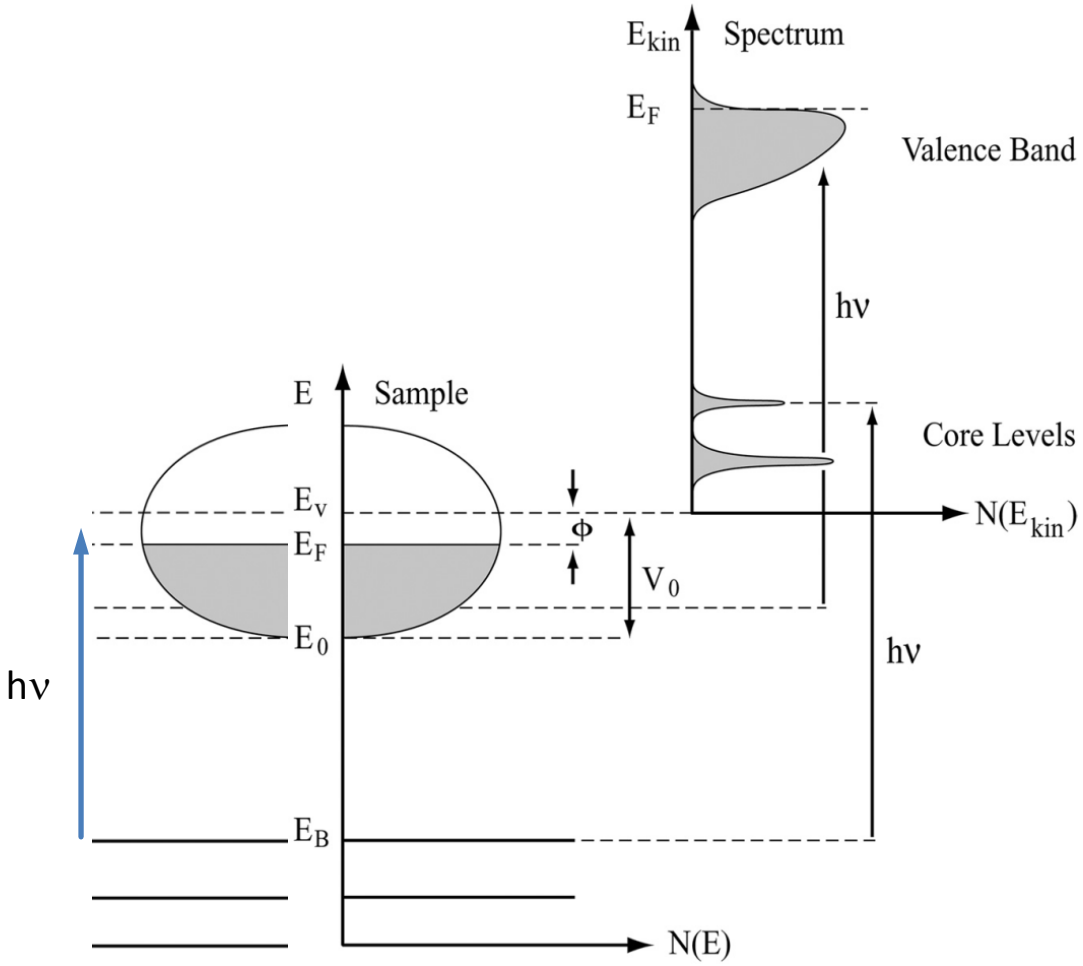
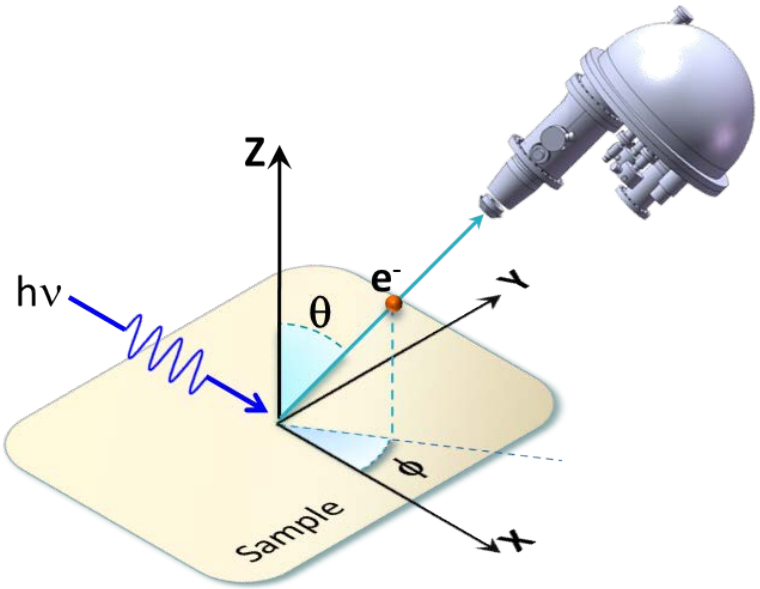
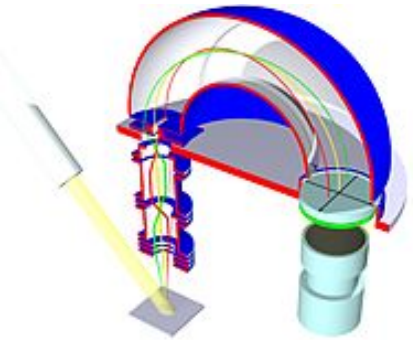


Damascelli, Physica Scripta (2004).

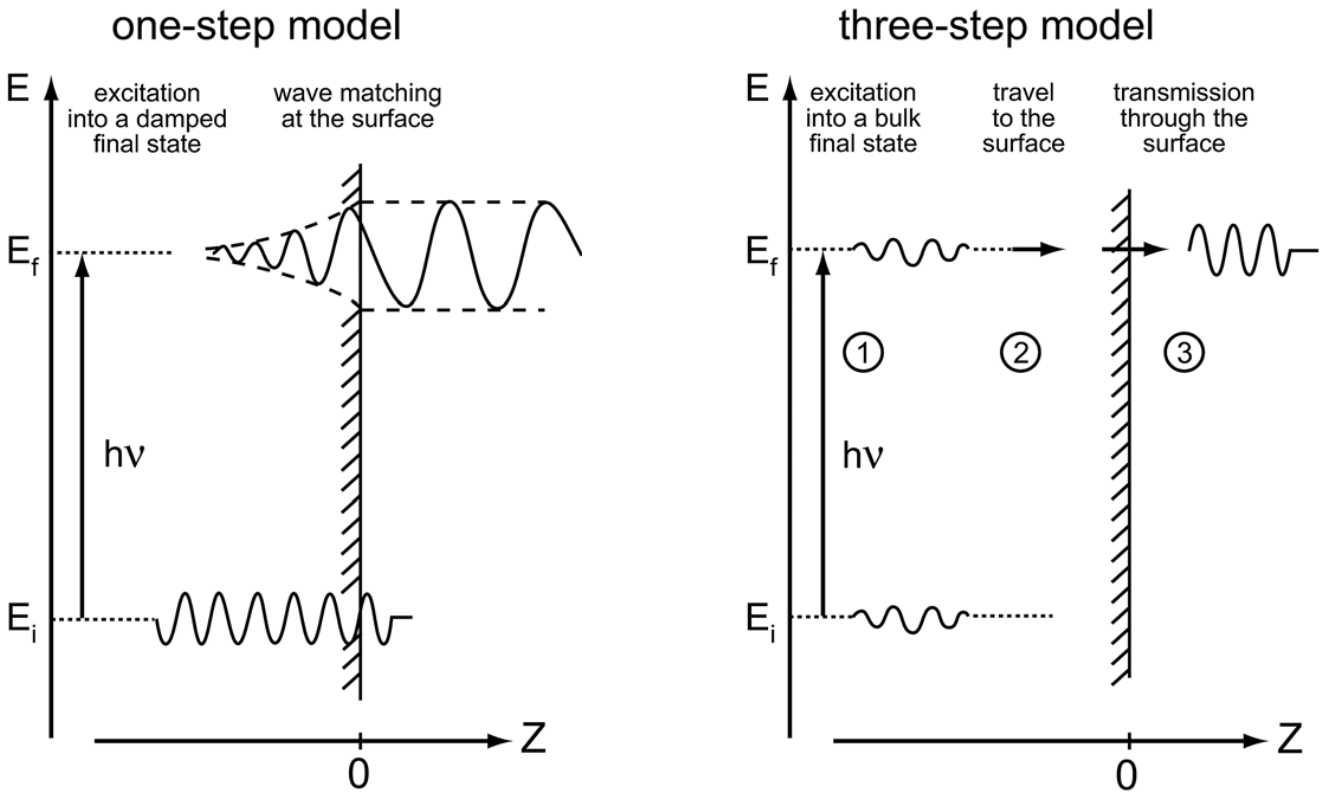
Angle-resolved photoemission





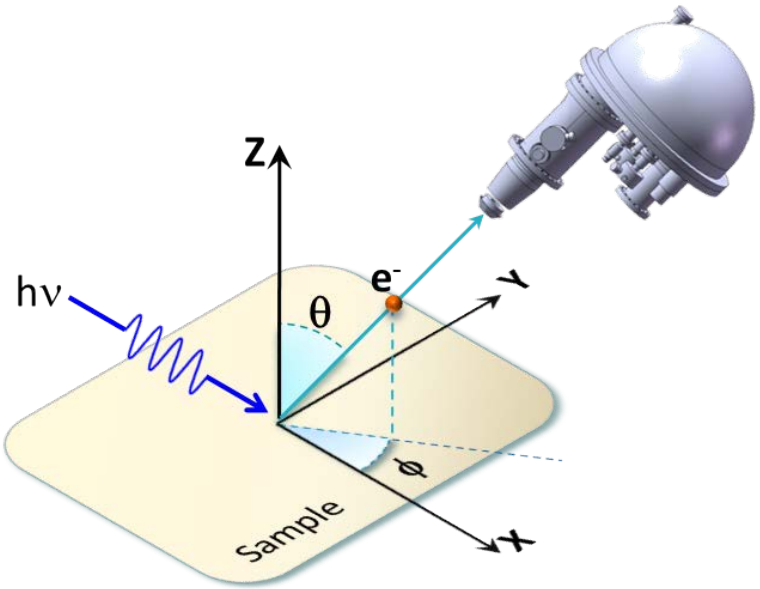
Oxford University, Wikipedia

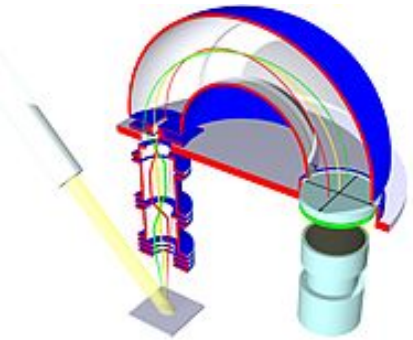
Initial & final state



Damascelli, Physica Scripta (2004).

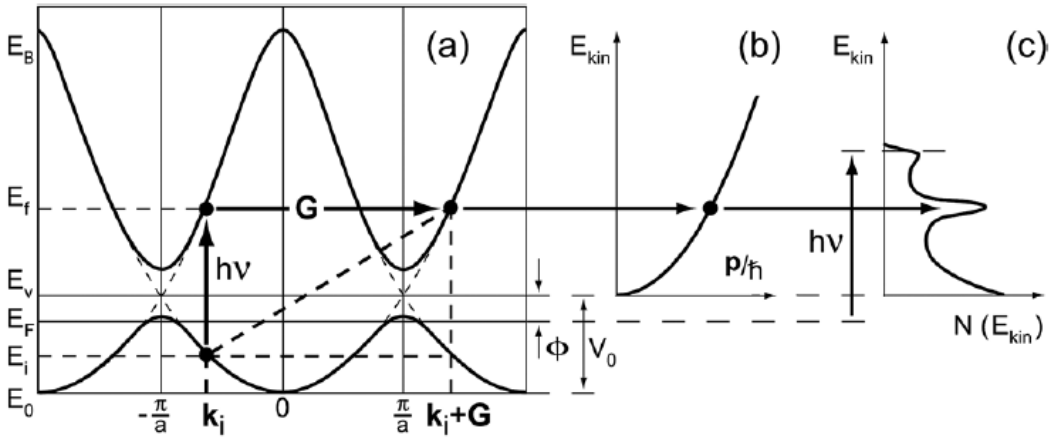
Angle-resolved photoemission





Oxford University, Wikipedia

ARPES kinematics & free electron



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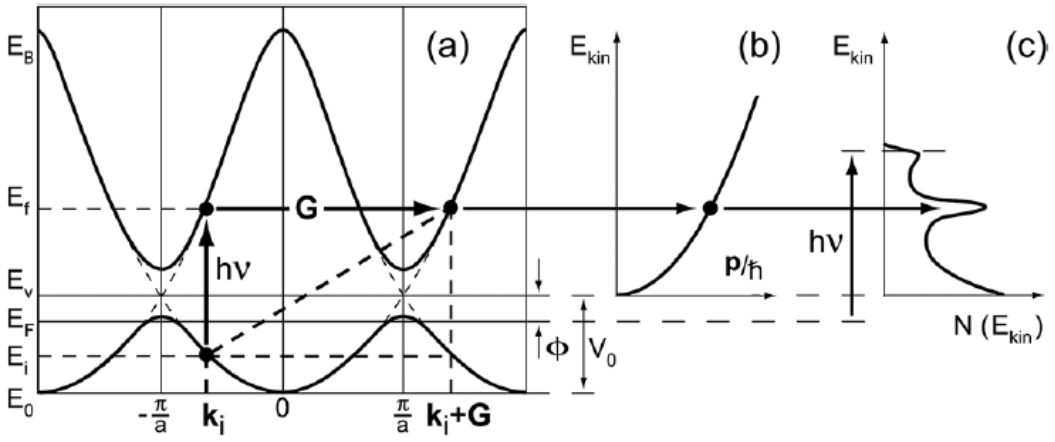
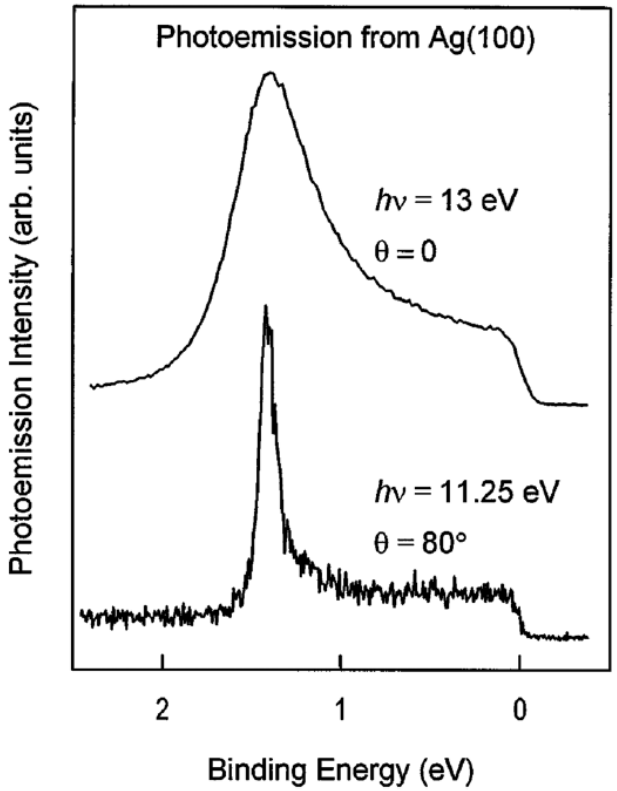
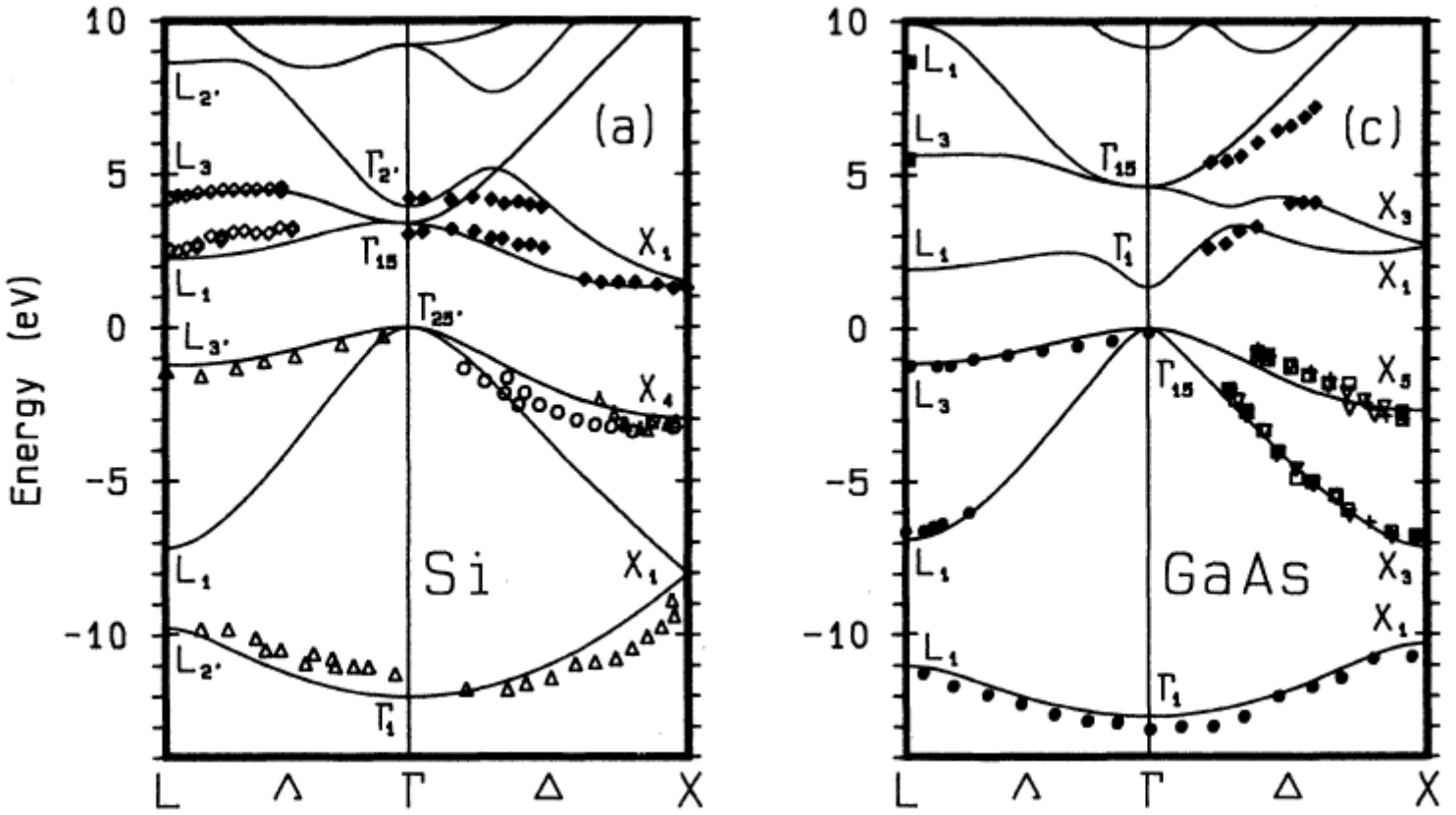




Damascelli, Physica Scripta (2004).

Remember: Silicon & GaAs



PHYSICAL REVIEW B VOLUME 21, NUMBER 8 15 APRIL 1980

Angle-resolved photoemission, valence-band dispersions $E(\vec{k})$, and electron and hole lifetimes for GaAs

T.-C. Chiang, J. A. Knapp,* M. Aono,† and D. E. Eastman
IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598
(Received 3 December 1979)

Accurate valence-band dispersions $E(\vec{k})$ along the major symmetry directions Γ-K-X, Γ-Δ-X, and Γ-Λ-L have been determined for GaAs using simple angle-resolved photoemission techniques of general utility with synchrotron radiation for $25 \leq h\nu \leq 100$ eV. At these photon energies, emission features can be understood within the direct-transition model, and spectral peaks can be classified roughly into two categories: one being those associated with primary cone emission with a lifetime-broadened free-electron-like final-state dispersion, and the other (usually weaker) being those associated with secondary cone-surface umklapp emission which emphasizes valence-band critical points with high state densities. Valence-band dispersions $E(\vec{k})$ along the Γ-K-X symmetry line perpendicular to the surface are determined using normal-emission spectra (primary cone peaks) from the (110) surface at various photon energies. Valence-band dispersions $E(\vec{k})$ along Γ-K-X, Γ-Δ-X, and Γ-Λ-L symmetry lines parallel to the surface are determined using off-normal emission spectra (primary cone peaks) from the same (110) surface with fixed perpendicular component of the electron momentum $\hbar\vec{k}_\perp$ at a zone center (extended-zone scheme) and varying parallel component of the electron momentum $\hbar\vec{k}_\parallel$, which are obtained by suitably varying $h\nu$ and emission angles. Experimental valence-band dispersions and critical points are compared with other theoretical and experimental results. Simple formulas are derived to relate the widths of spectral peaks to electron and hole lifetimes. Initial hole lifetimes at valence critical points and typical final electron lifetimes are obtained. The latter yields final-state momentum broadenings (typically $\lesssim 10\%$ of the Brillouin-zone size) which are consistent with the direct-transition model.

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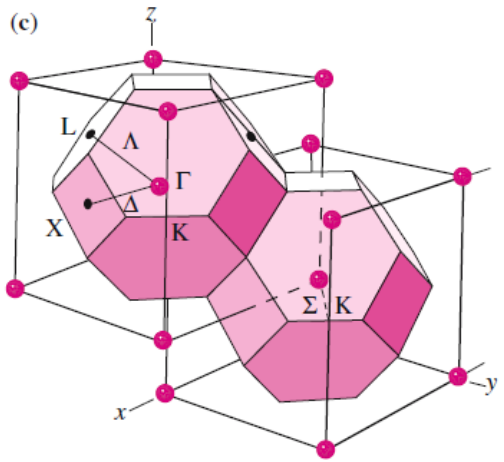
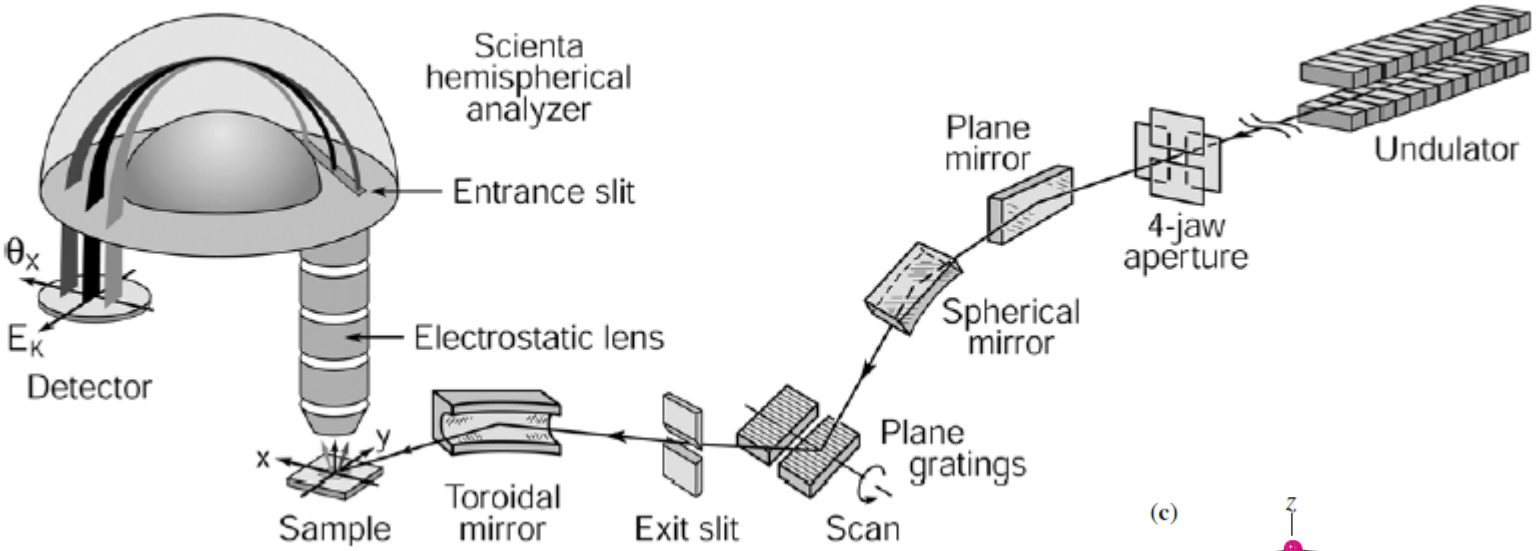
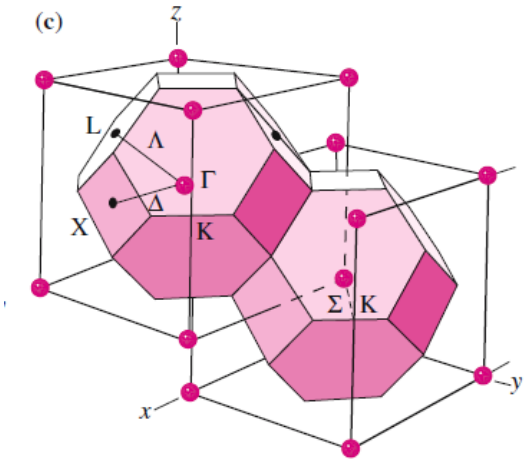
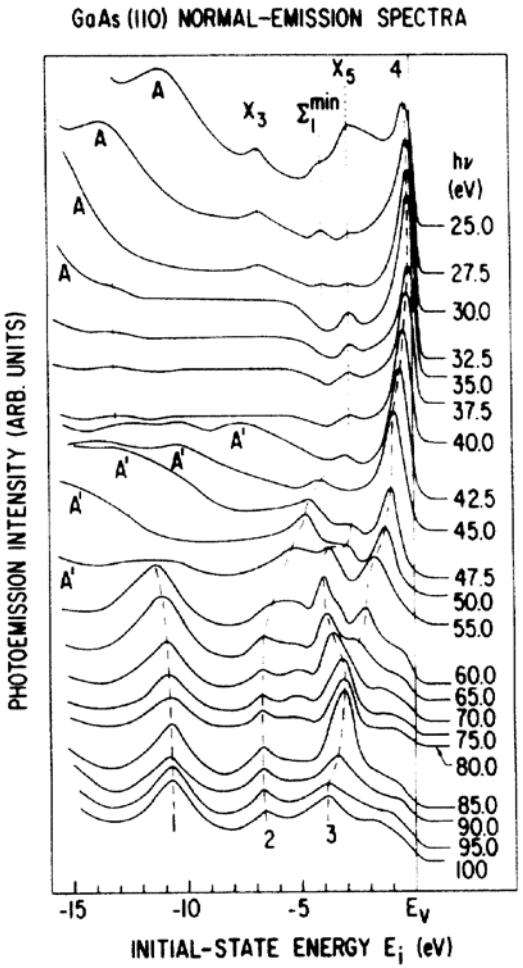


ARPES experiment

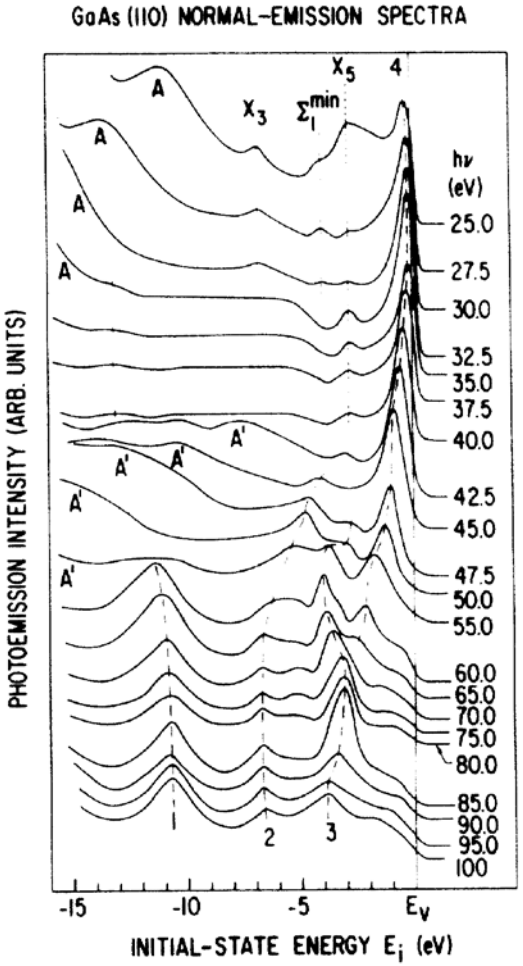


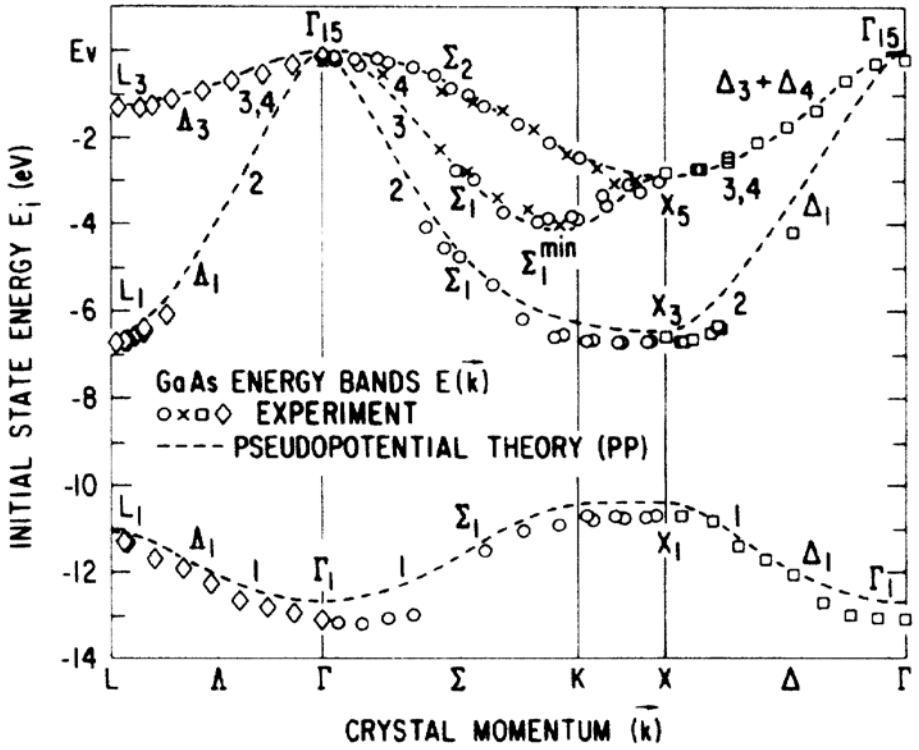


Normal incidence

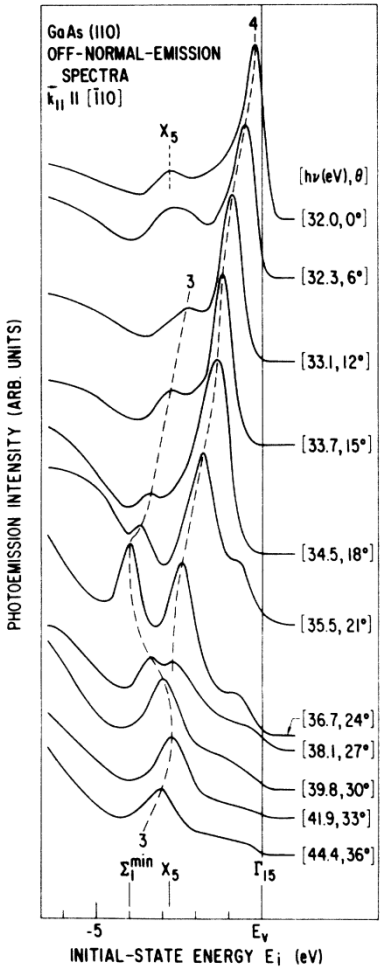


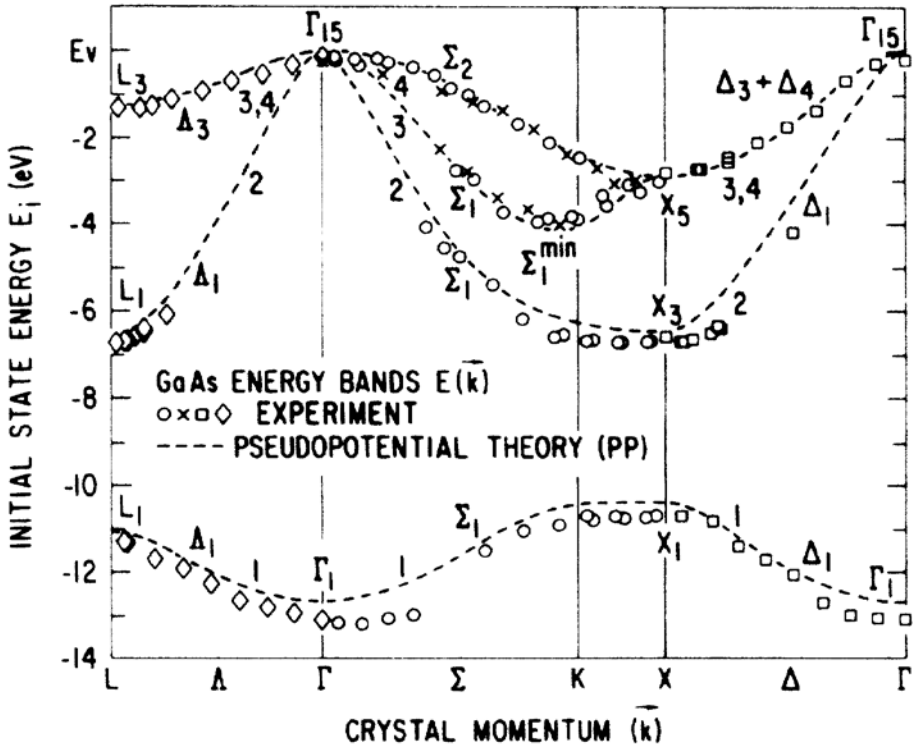
Normal incidence



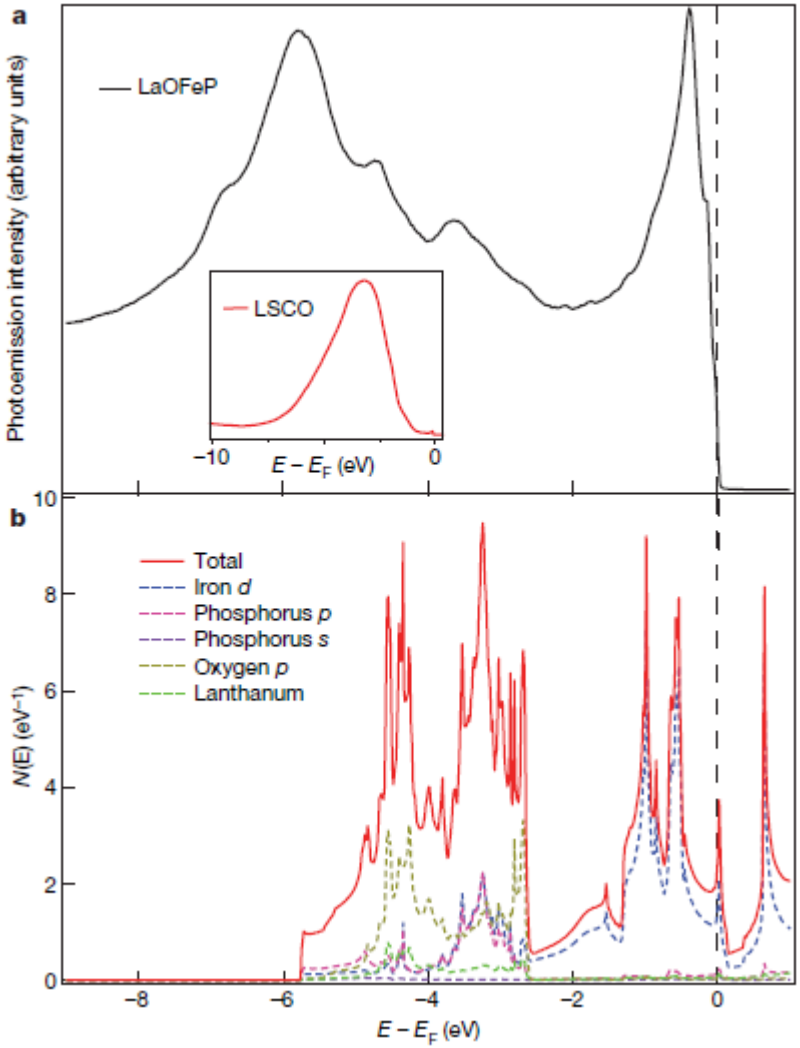


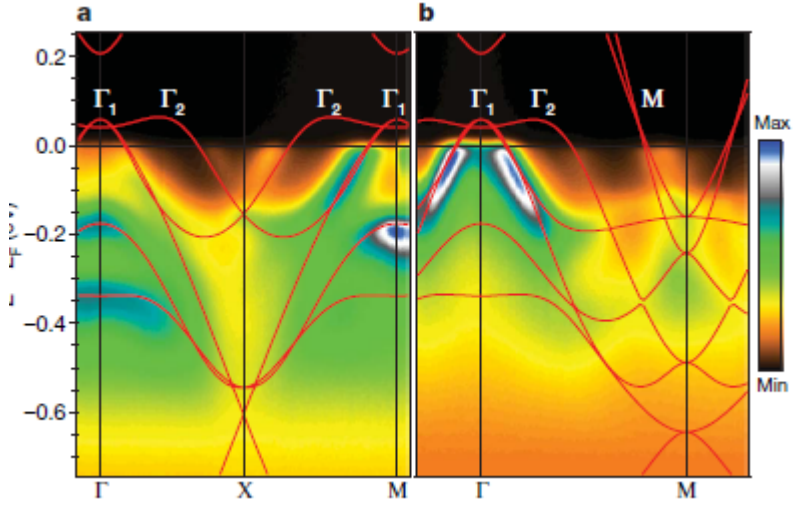
Normal incidence





LaOFeP


a
LaOFeP
LSCO
−10
0
$E - E_F$ (eV)
Photoemission intensity (arbitrary units)
b
Total
Iron d
Phosphorus p
Phosphorus s
Oxygen p
Lanthanum
N(E) (eV⁻¹)
10
8
6
4
2
0
−8
−6
−4
−2
0
$E - E_F$ (eV)


a
b
0.2
0.0
−0.2
−0.4
−0.6
Γ1
Γ2
Γ2
Γ1
Γ1
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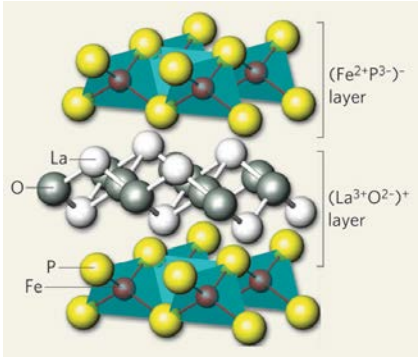
M
Max
Min
Γ
X
M
Γ
M


(Fe2+P3-)- layer
La
O
(La3+O2-)+ layer
P
Fe