In-situ doping control of the surface of cuprates

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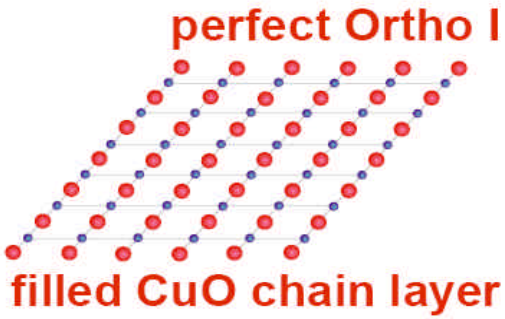
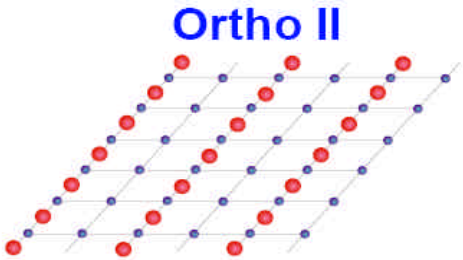
E. Rotenberg

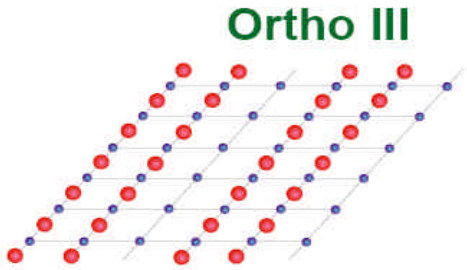
Nature Physics **4**, 527 (2008)

Clean Gateway to High-Tc Superconductivity

Underdoped YBCO 6.5

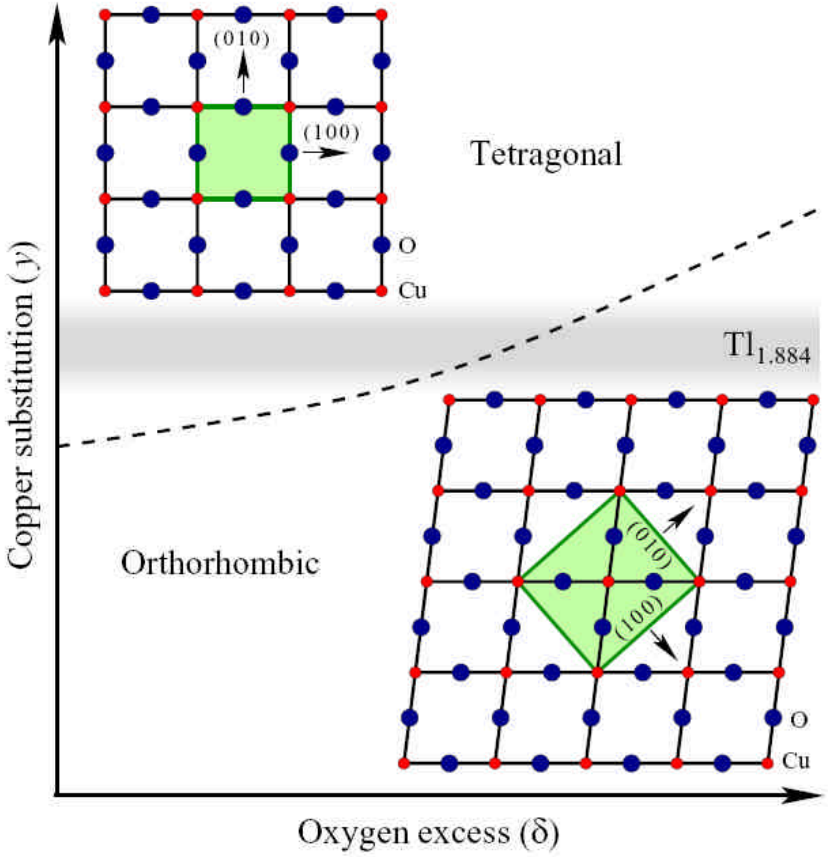






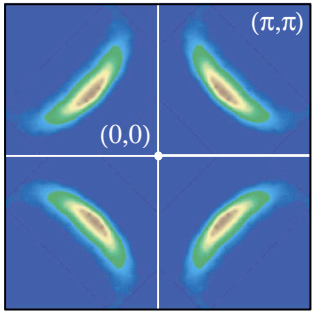
UBC Single Crystals
Liang - Bonn - Hardy

Overdoped Tl2201



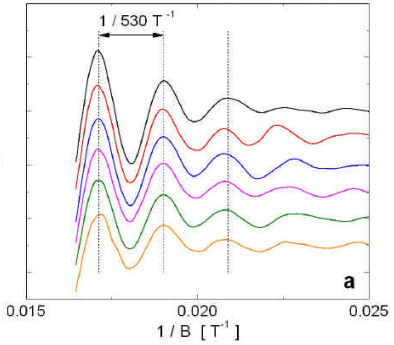
Fermiology across the Cuprate Phase Diagram

CCOC - x=0.12



ARPES – Shen (05)

YBCO - x=0.10

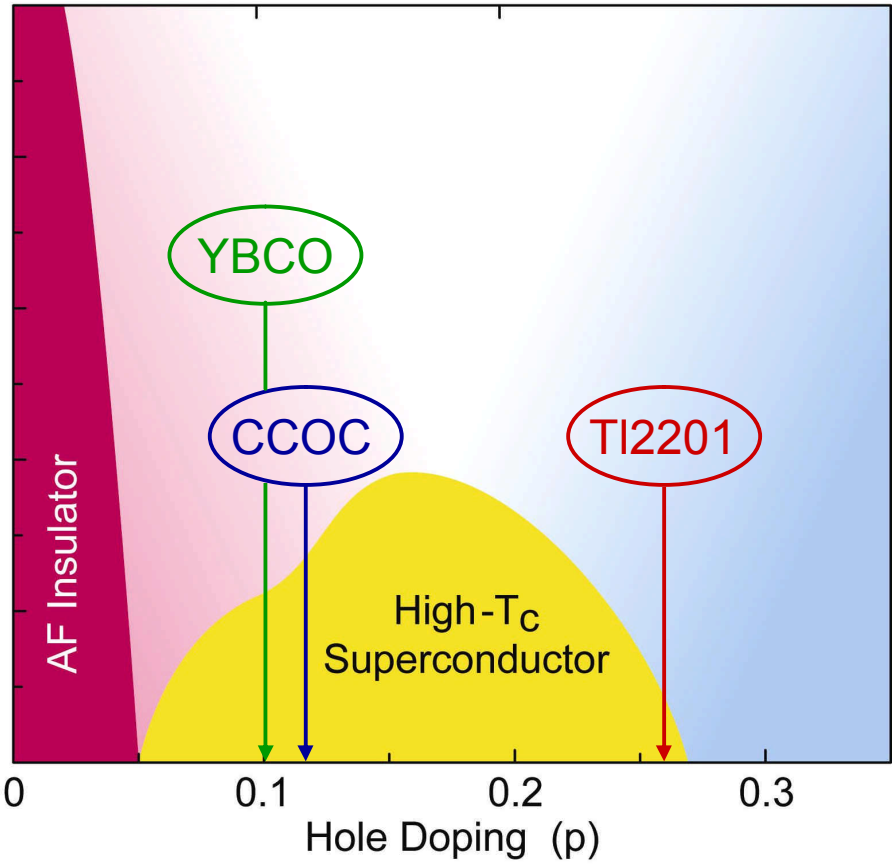


QO – Doiron-Leyraud (07)

ARPES on YBCO6.5

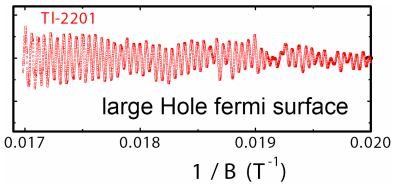
Overdoped Tl2201

Quantitative agreement between single-particle and transport probes

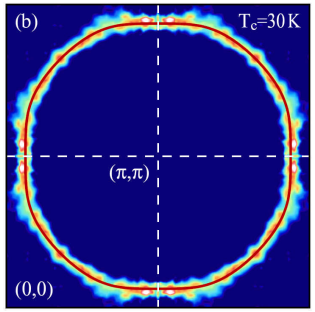


Can this be the gateway to a unified picture for underdoped cuprates?

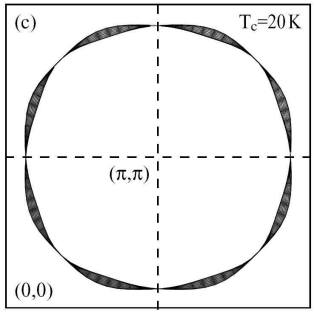
Tl2201 - x=0.26



dHvA – Vignolle (08)



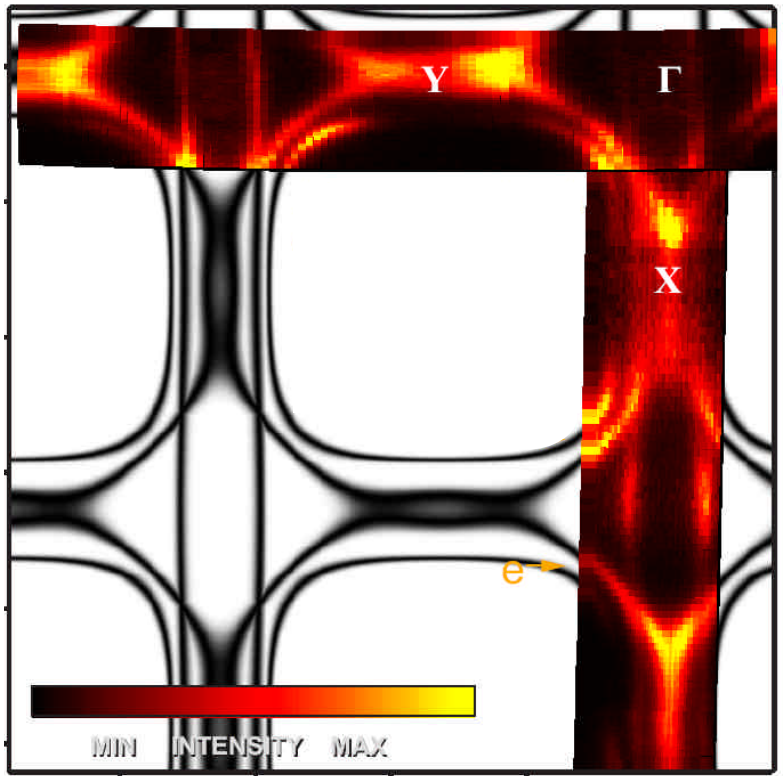
ARPES – Platé (05)



AMRO – Hussey (03)

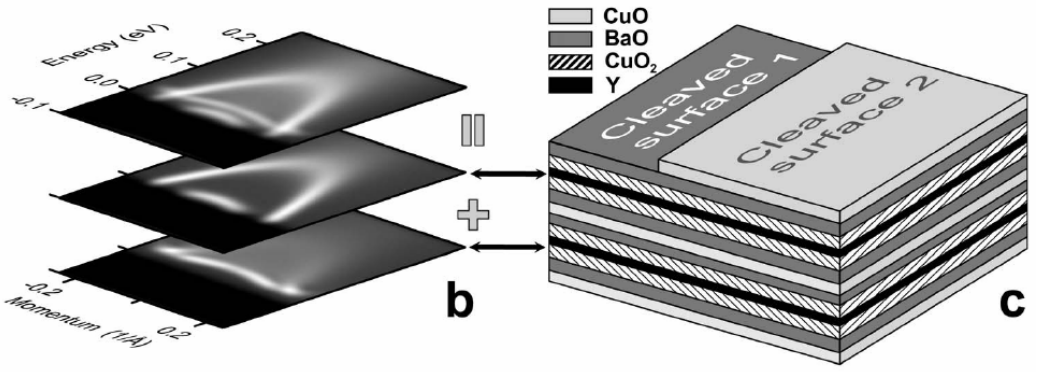
Fermiology of YBCO by ARPES

YBCO 6.40 – 6.85: Highly overdoped Fermi surface



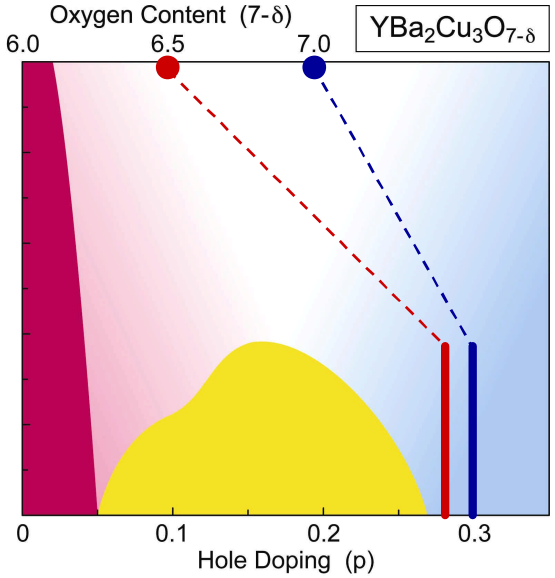
x~0.3

Lack of natural cleavage plane



Zabolotnyy, Borisenko et al.
PRB **76**, 064519 (2006)

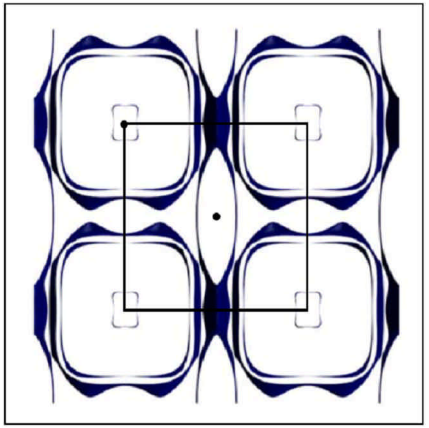
Fermiology of YBCO by ARPES

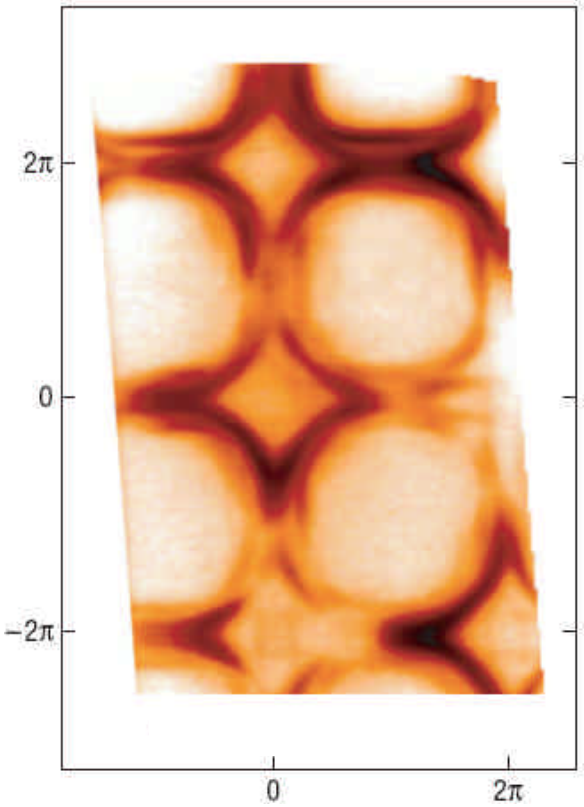


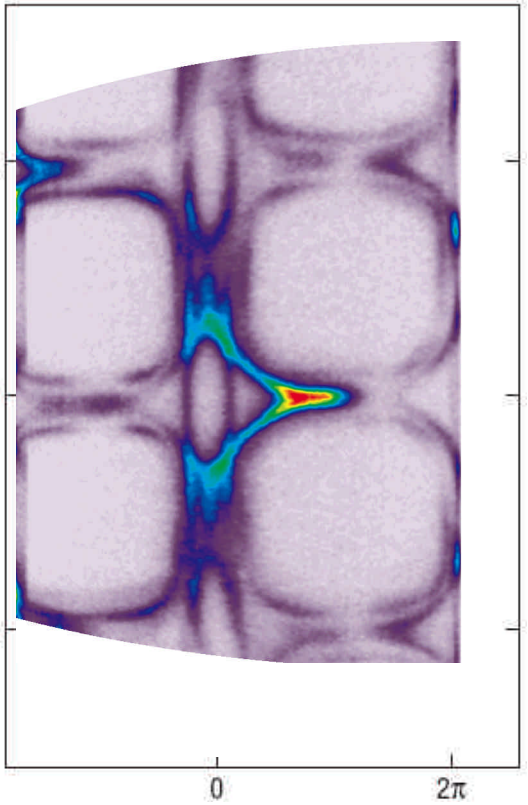
Large doping almost independent of oxygen content

Fermi surface of twinned $YBa_2Cu_3O_{6.51}$

Fermi surface of detwinned $YBa_2Cu_3O_{6.99}$





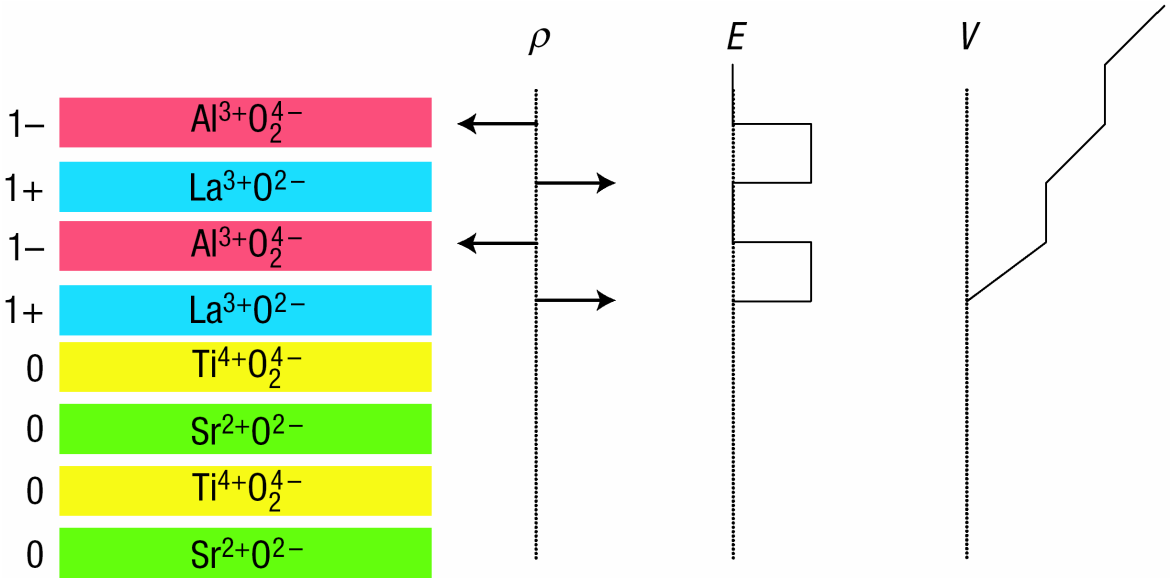


Elfimov et al.
PRB **77**, 060504 (2008)

Hossain et al.
Nature Physics 2008

Fournier et al.
Unpublished 2008

Electronic Surface Reconstruction in $YBa_2Cu_3O_{6+x}$



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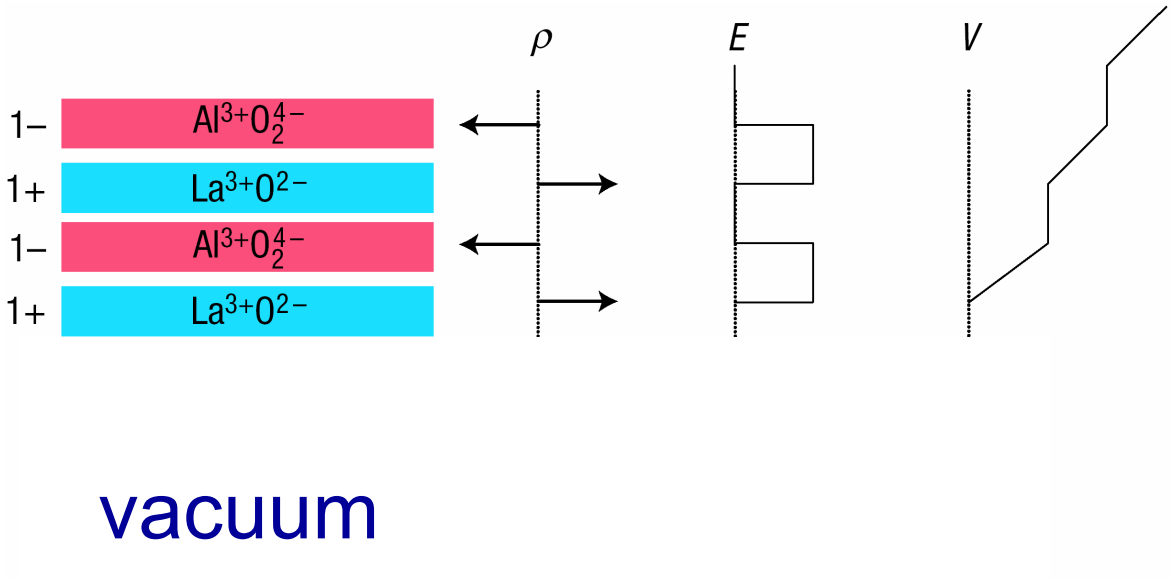
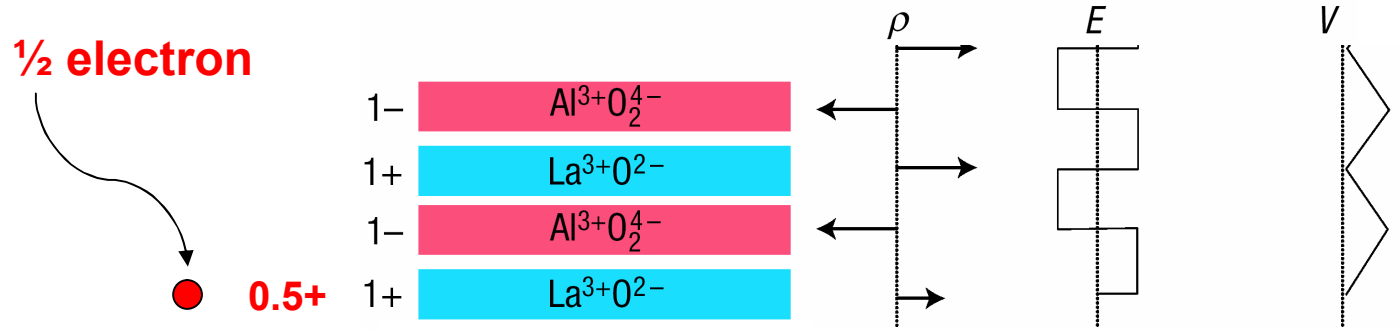
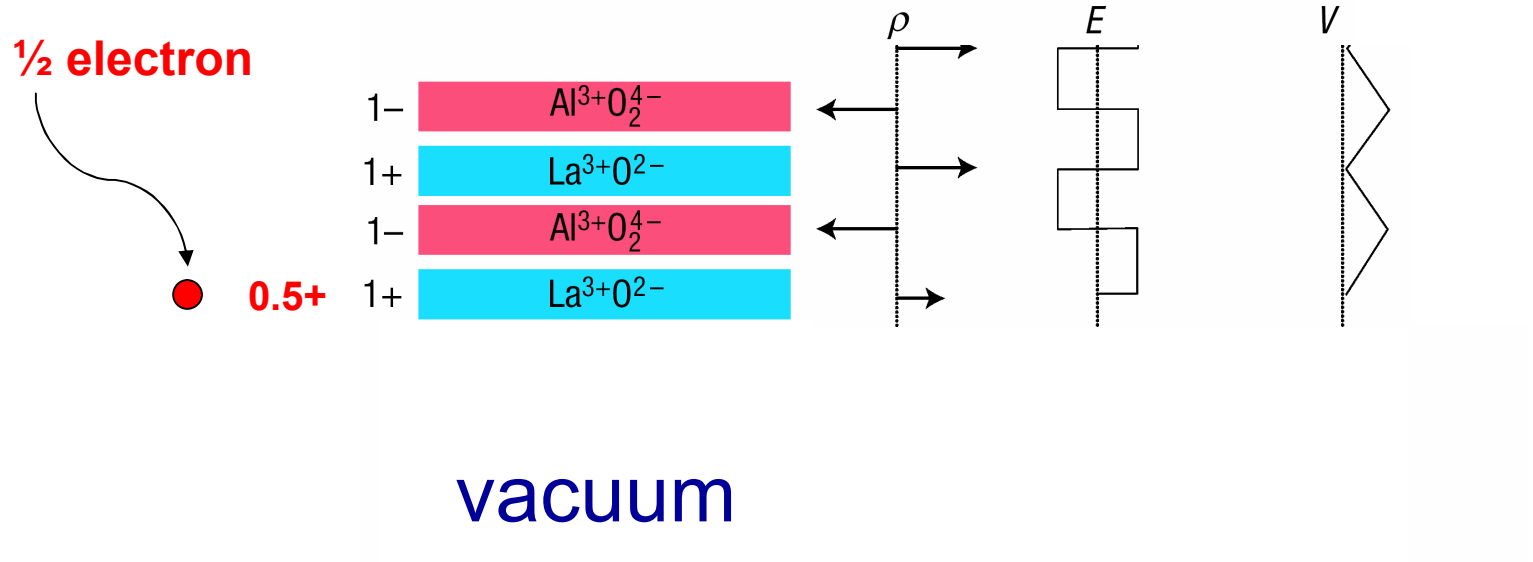


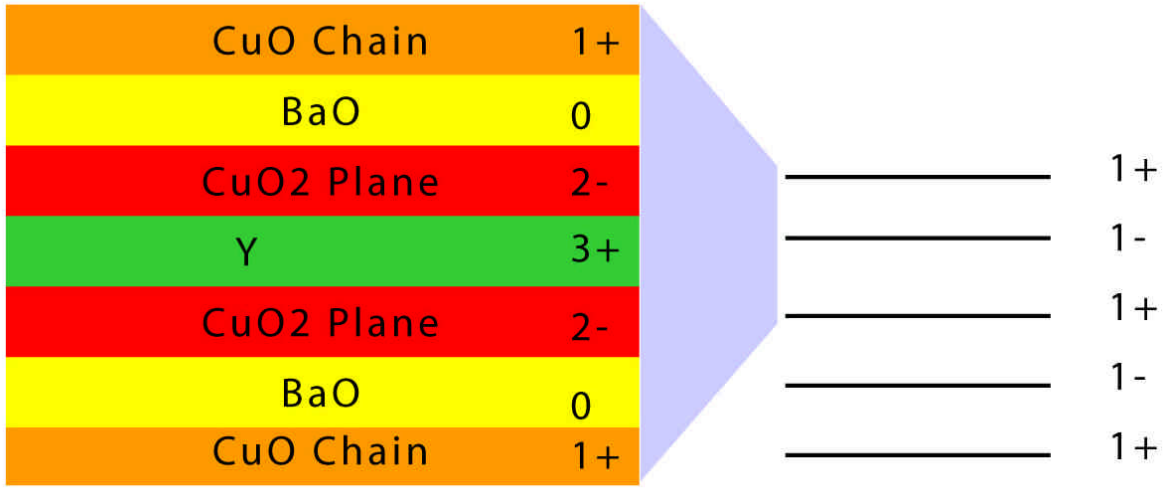
Electronic Surface Reconstruction in $YBa_2Cu_3O_{6+x}$



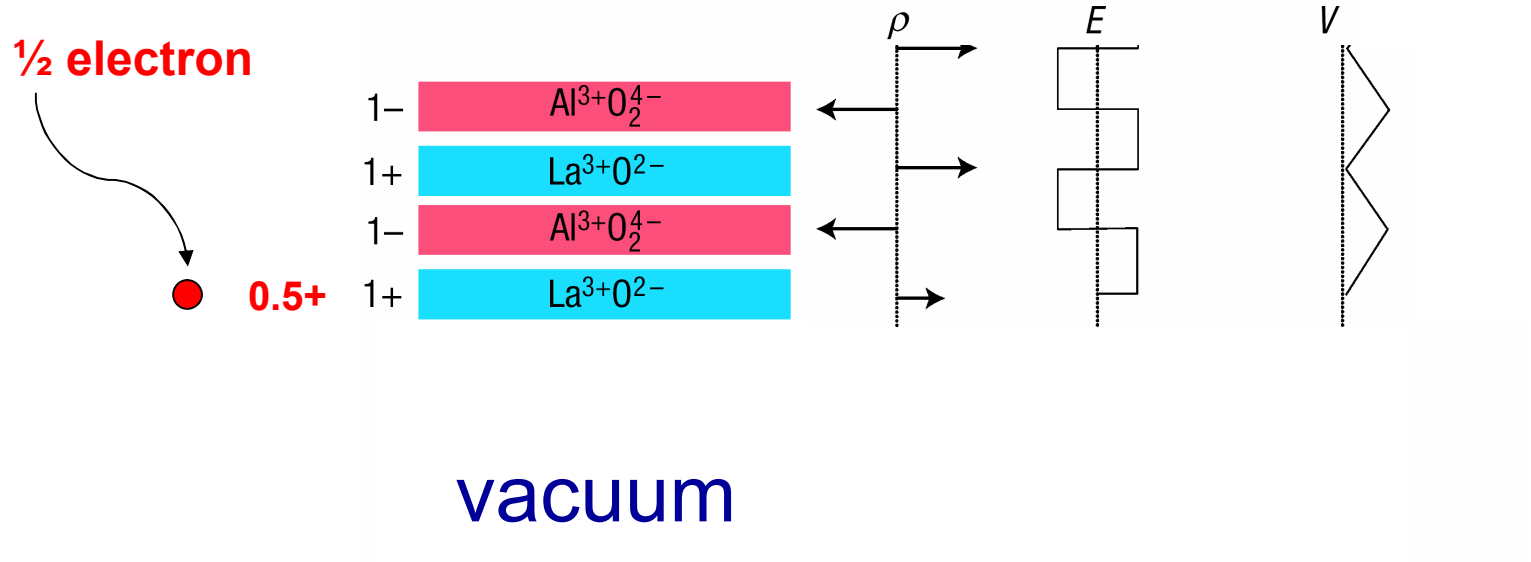
vacuum

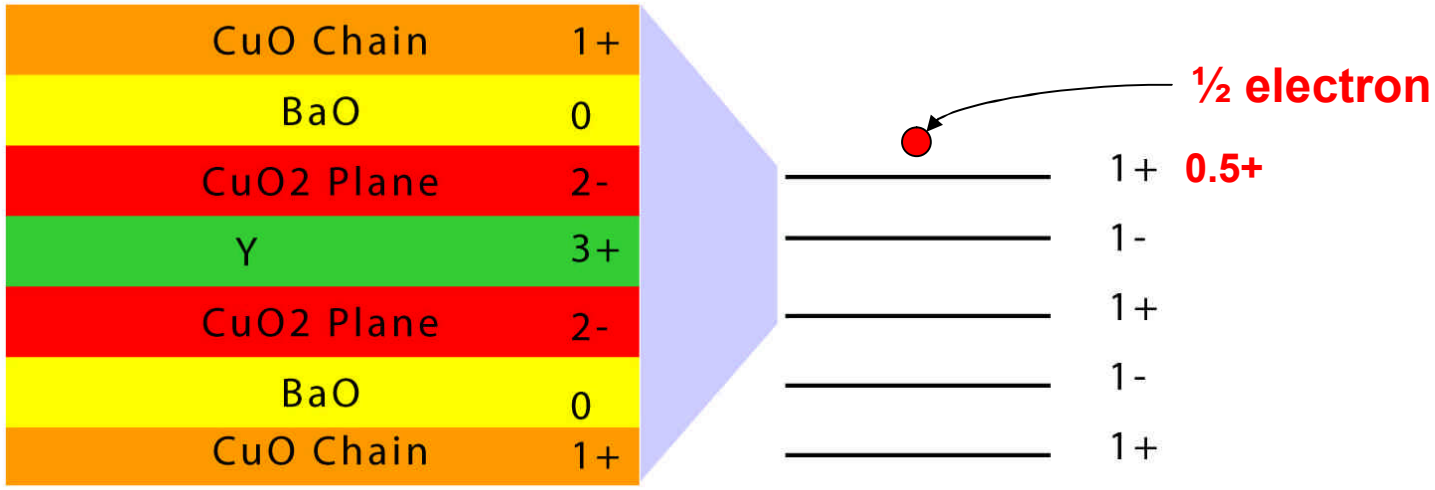
Electronic Surface Reconstruction in $YBa_2Cu_3O_{6+x}$



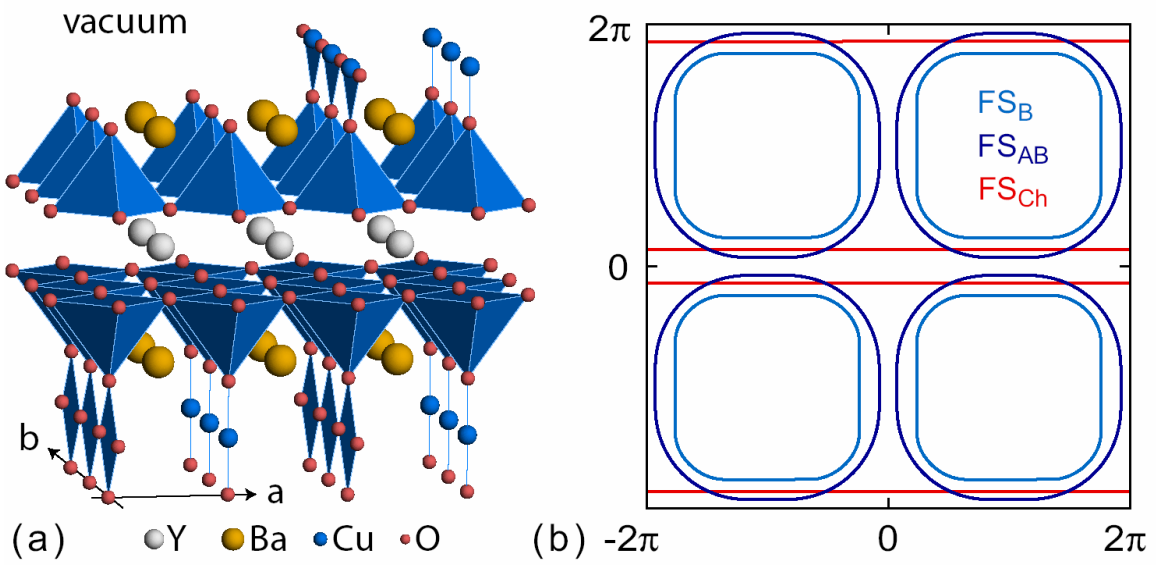


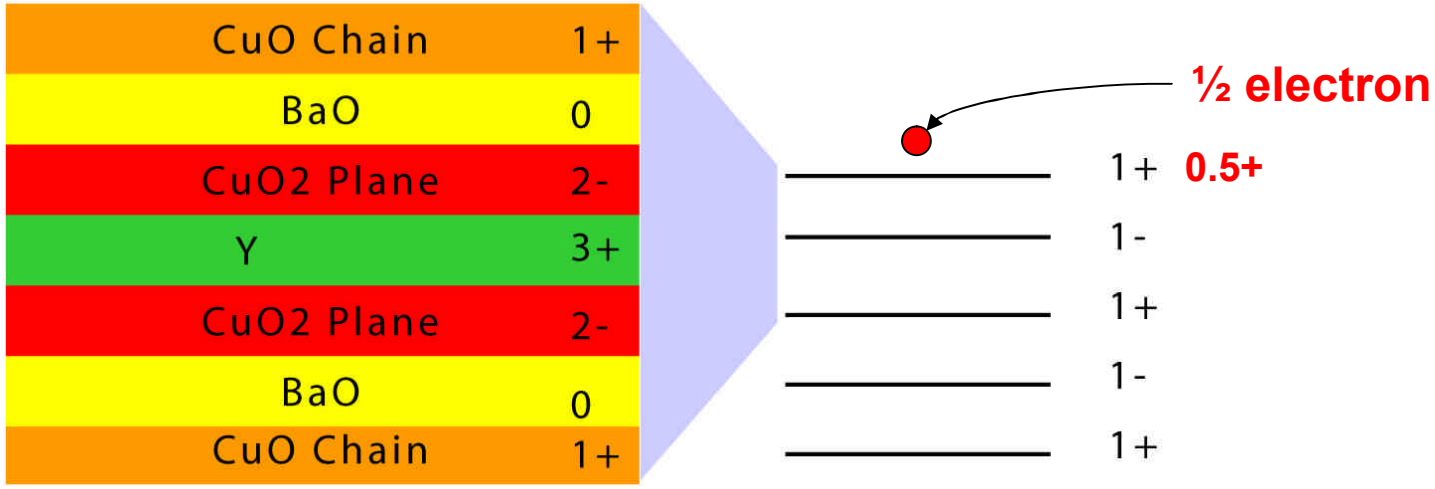
Electronic Surface Reconstruction in $YBa_2Cu_3O_{6+x}$



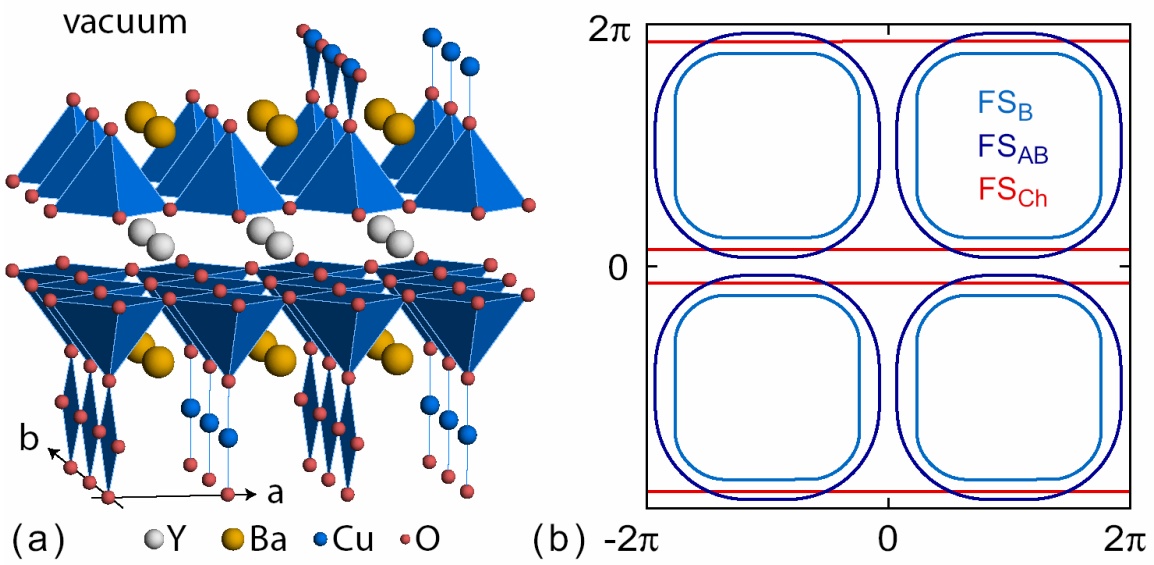


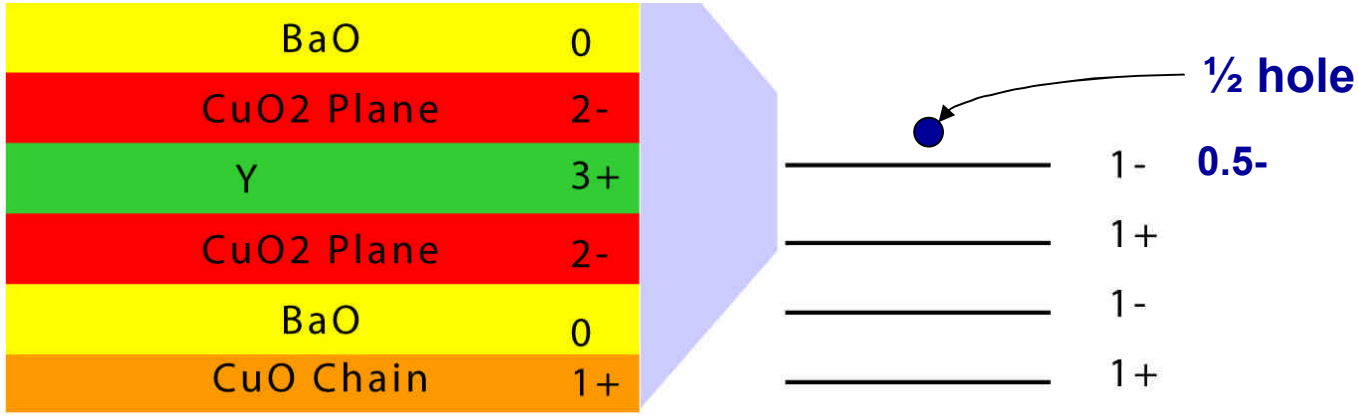
Electronic Surface Reconstruction in $YBa_2Cu_3O_{6+x}$



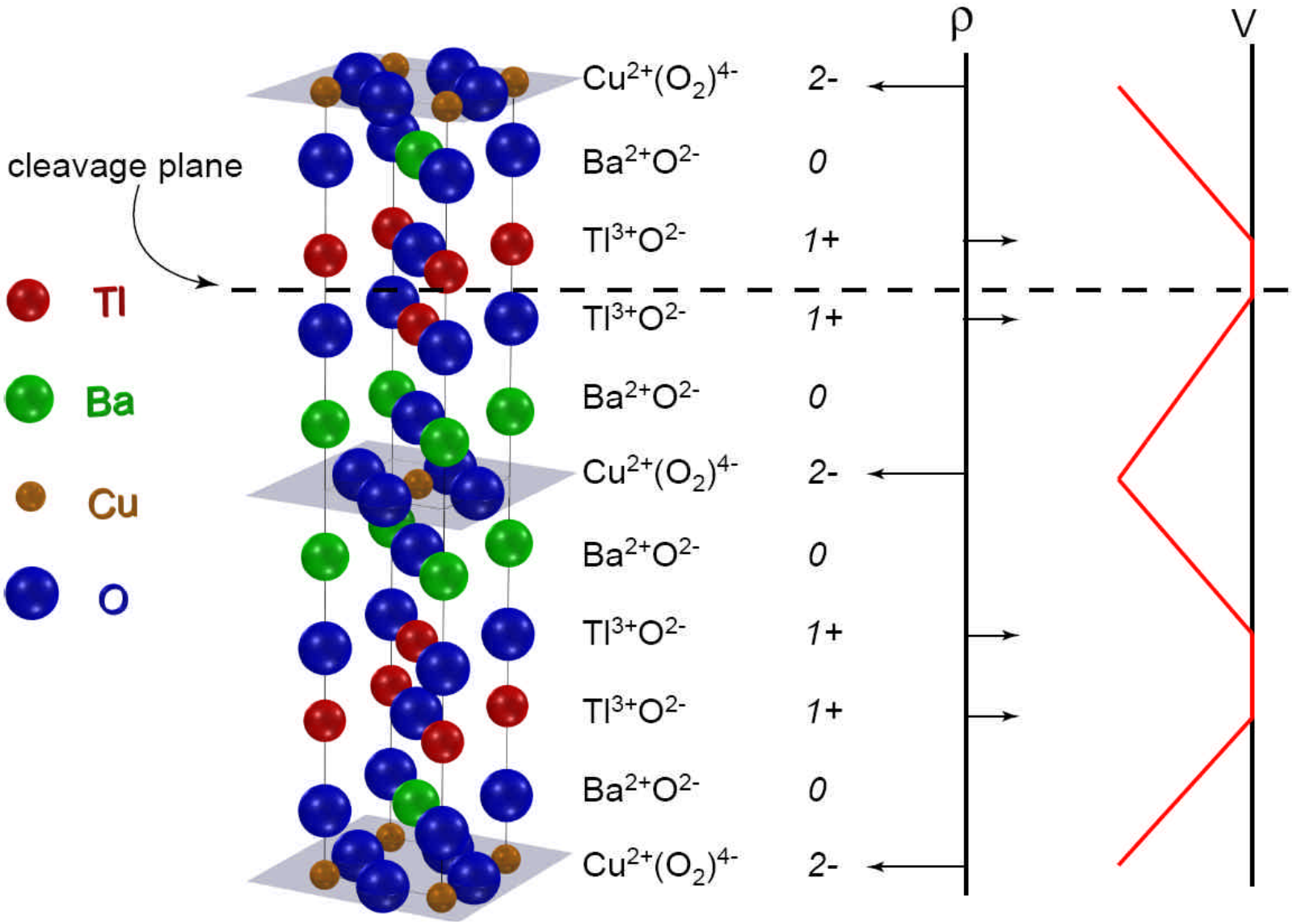


Electronic Surface Reconstruction in $YBa_2Cu_3O_{6+x}$

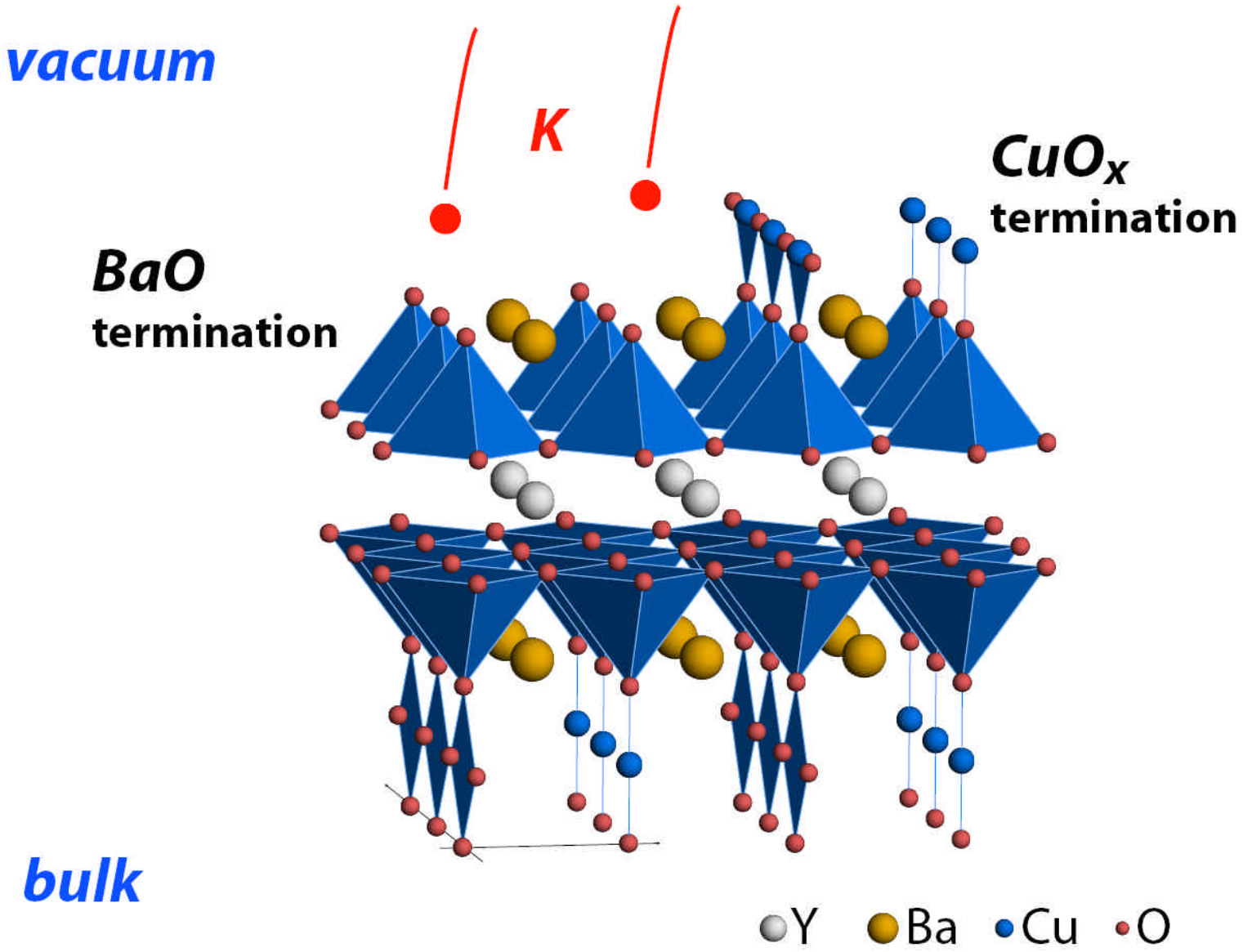




Is the Surface of $Tl_{2-y}Ba_2Cu_{1+y}O_{6+x}$ polar? NO!!



Fixing the YBCO surface self-doping by K deposition

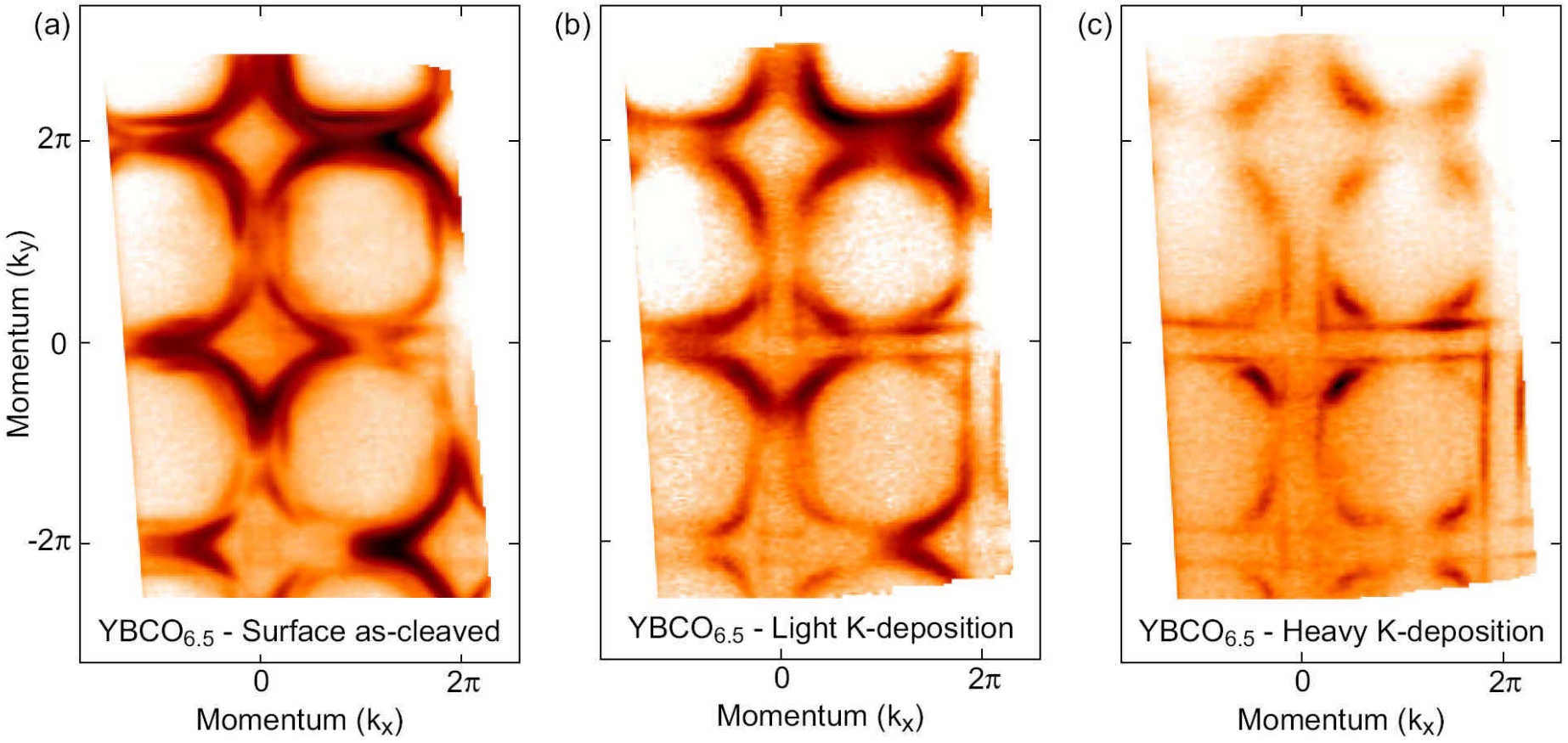


Our ARPES studies of Ortho-II YBCO6.5

Fresh

Surface Treatment 1

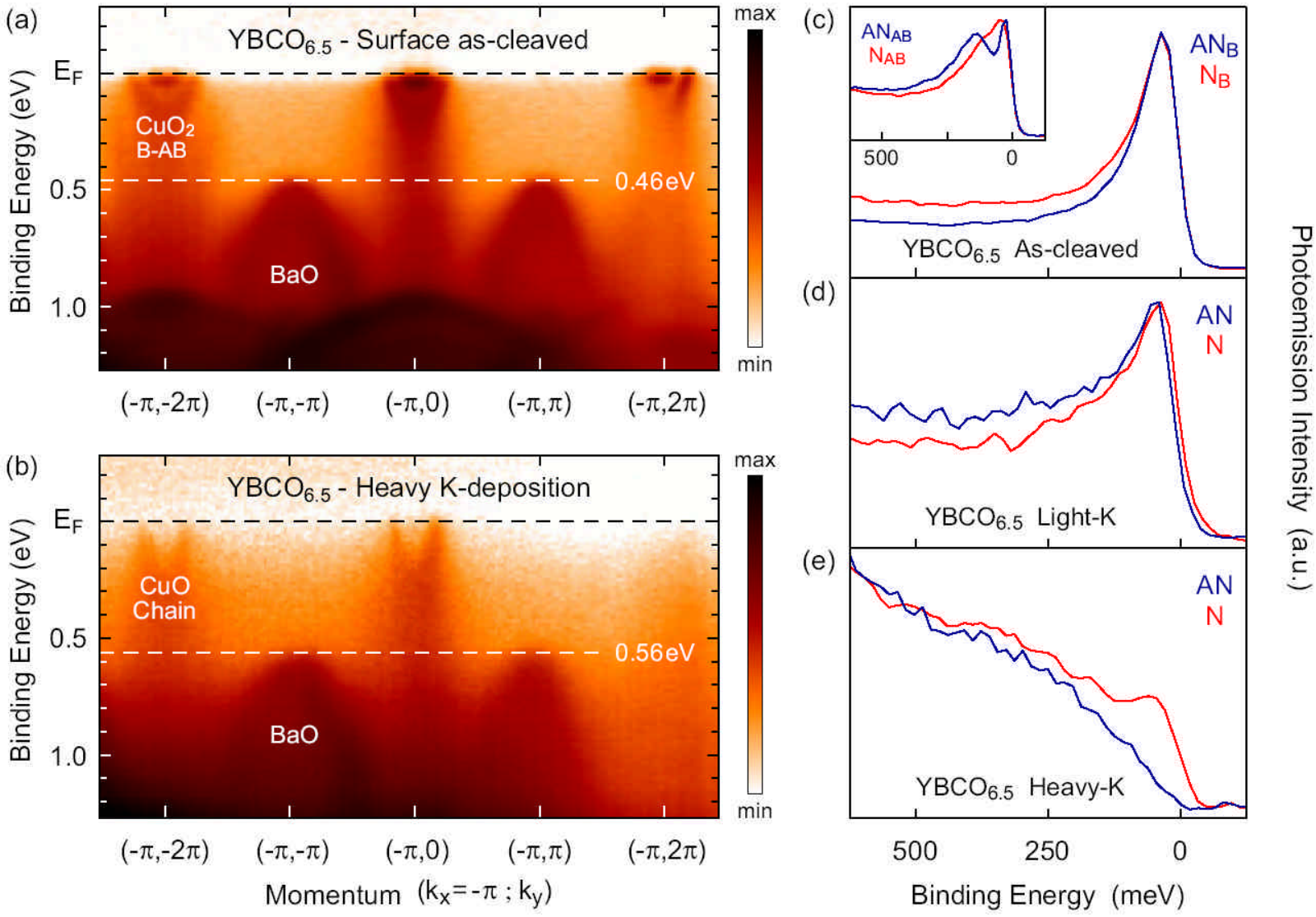
Surface Treatment 2



Electron doping

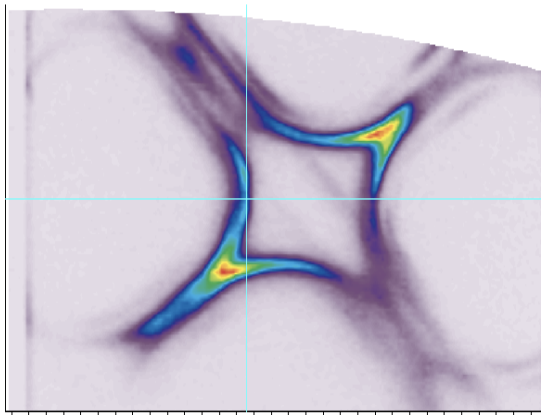
LDA → **Fermi arcs**

Our ARPES studies of Ortho-II YBCO6.5

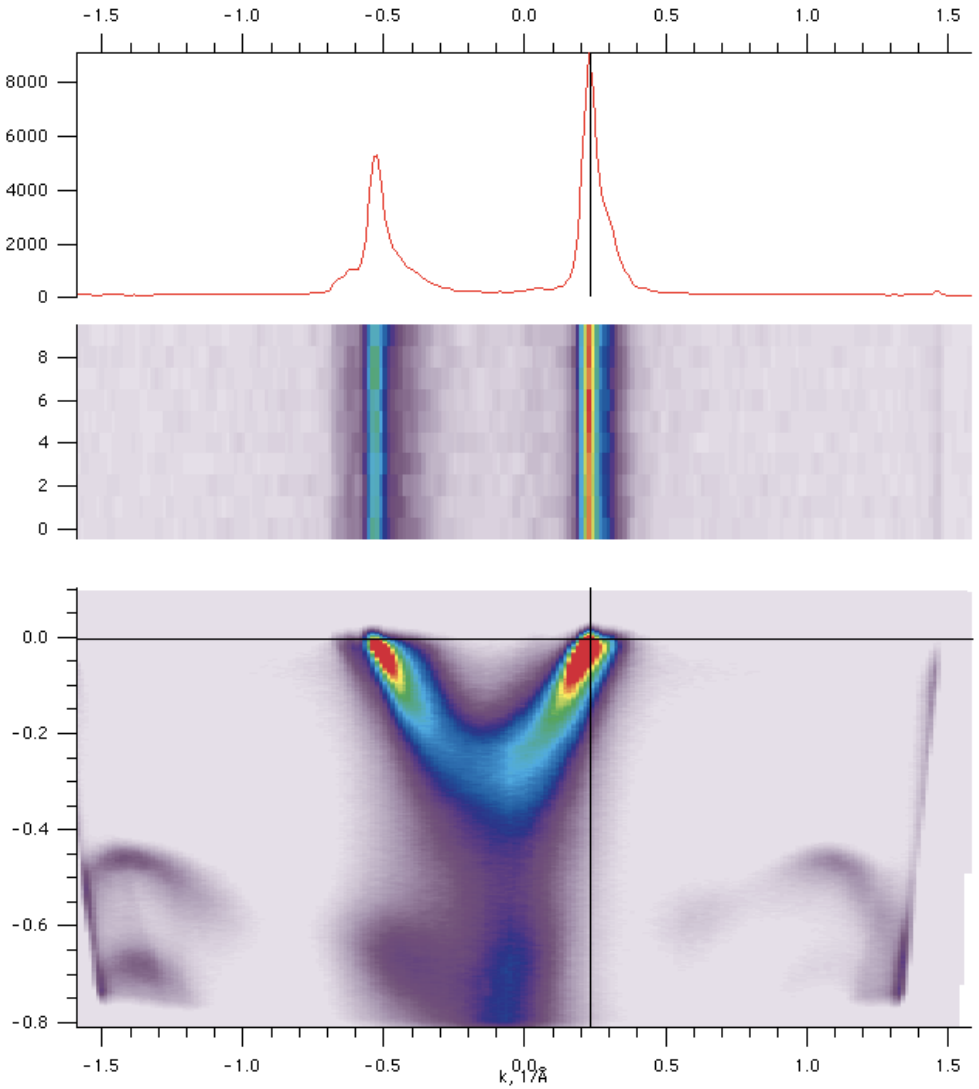


Hossain et al., Nature Physics 4, 527 (2008)

Our ARPES studies of Ortho-II YBCO7.0

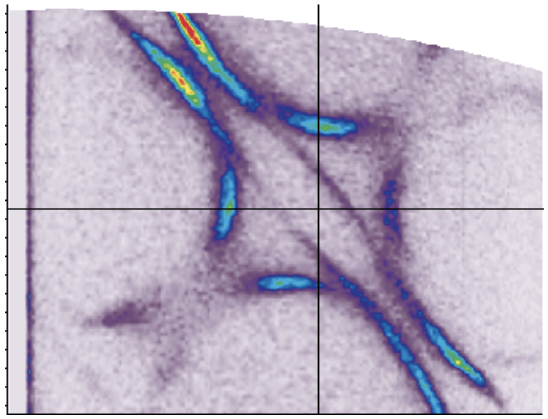


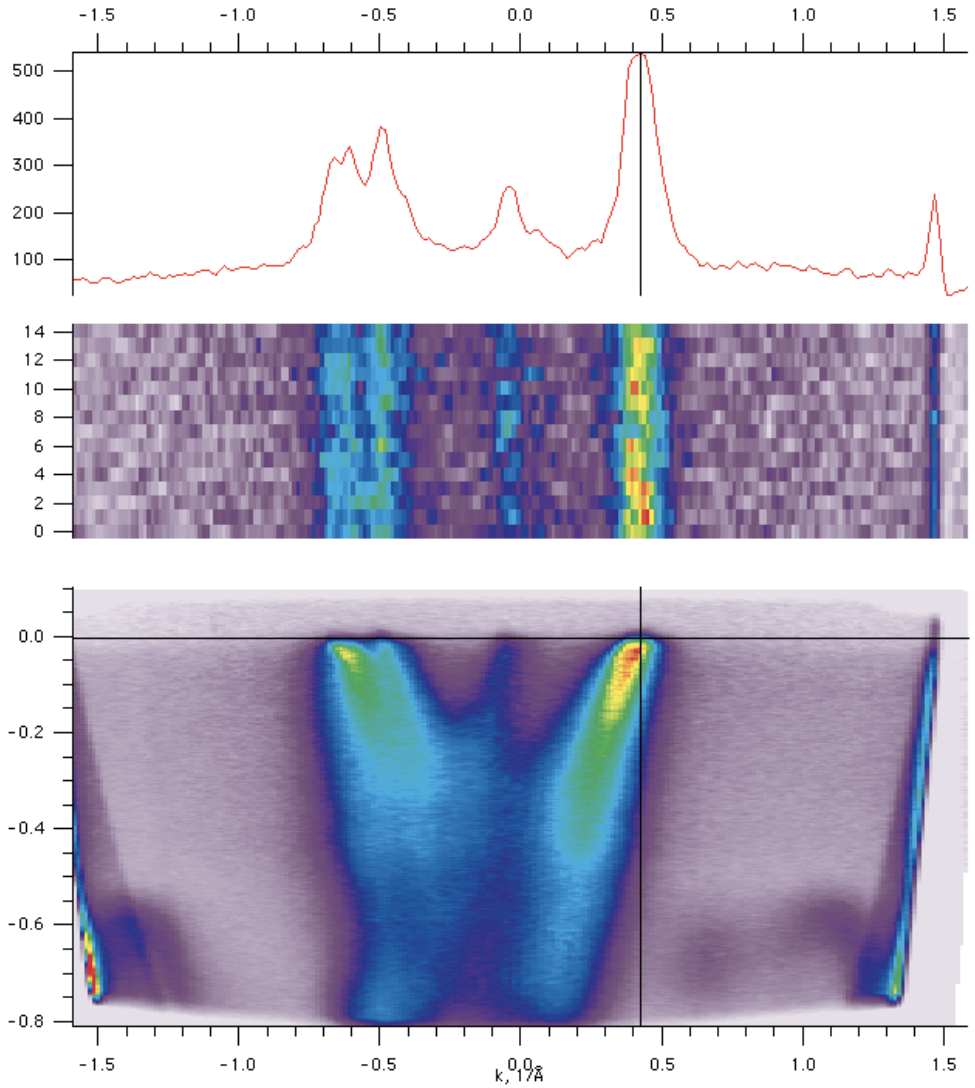
As-Cleaved



Fournier et al., unpublished (2008)

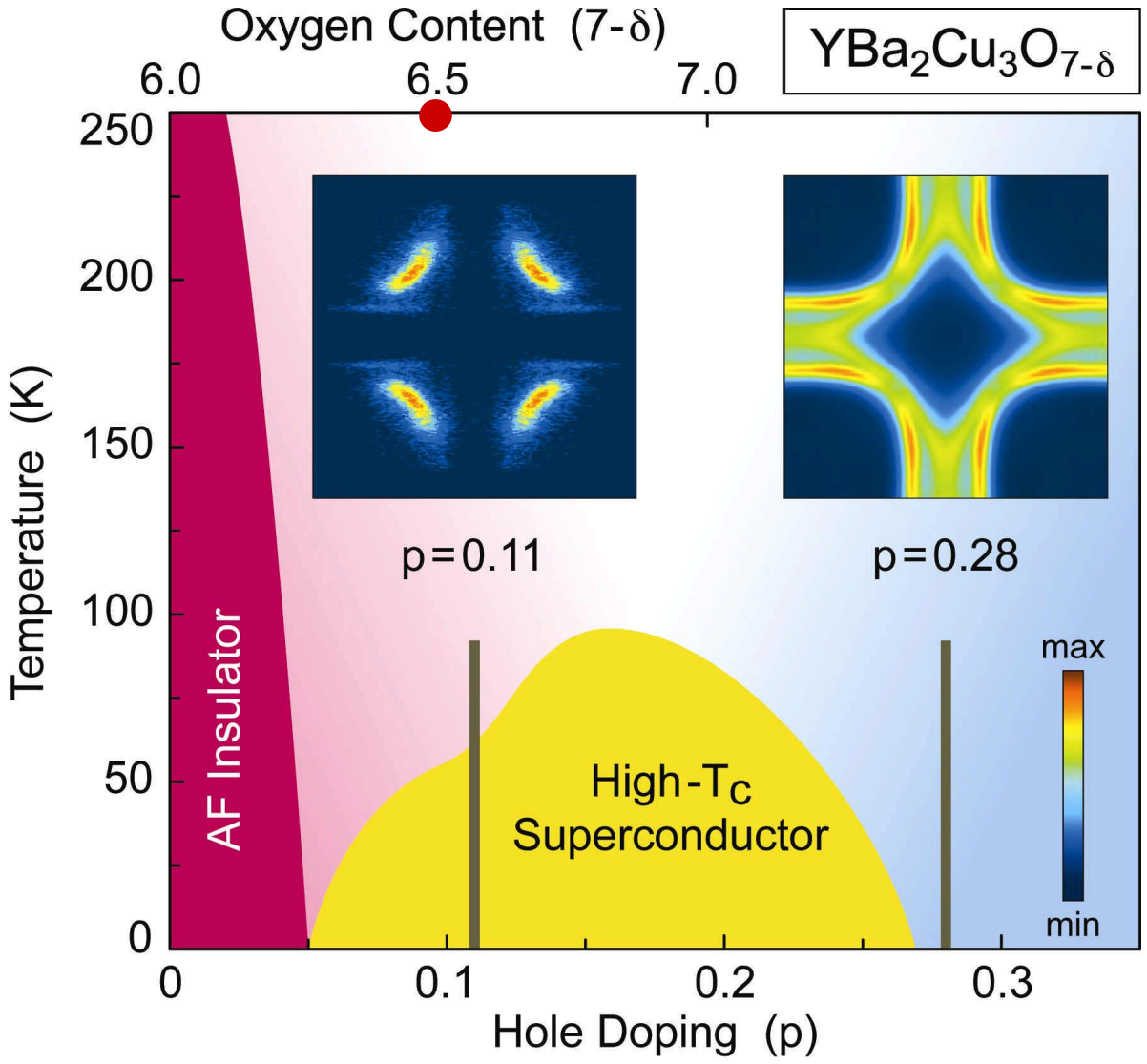
Our ARPES studies of Ortho-II YBCO7.0





Fournier et al., unpublished (2008)

ARPES on Ortho-II YBCO6.5: Conclusions



Hossain et al., Nature Physics 4, 527 (2008)

In-situ doping control
Polar catastrophe
Surface self doping

Universality in ARPES
OD: Large Fermi surface
UD: Fermi arcs, pseudogap

Bulk-surface discrepancy
Surface is different?
Surface disorder?
Arcs are pockets?
Field-induced pockets?
No truly close orbits?
Magnetic breakdown?