

Dramatic enhancement in T_c with year since the discovery of high- T_c copper oxides at 1986

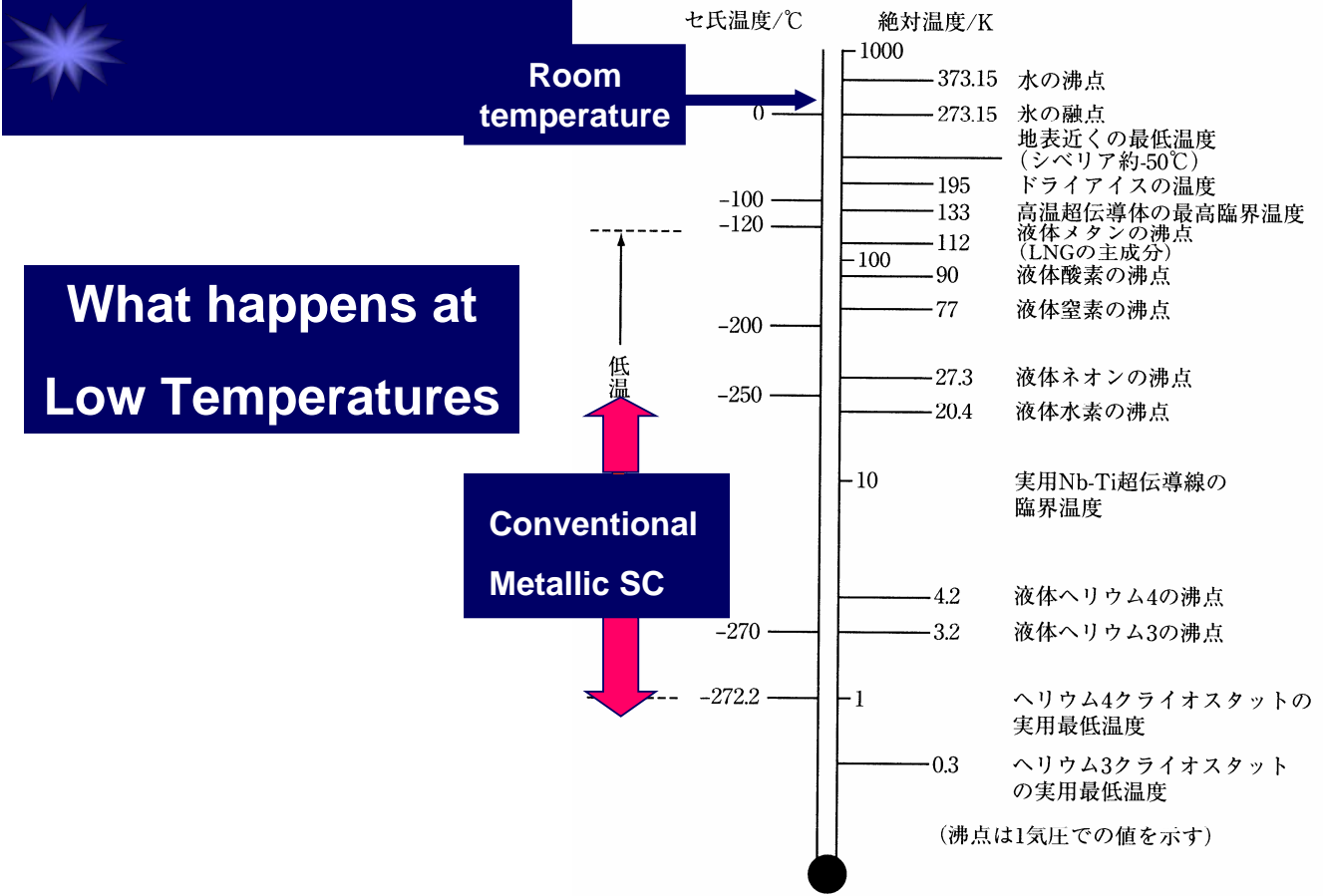
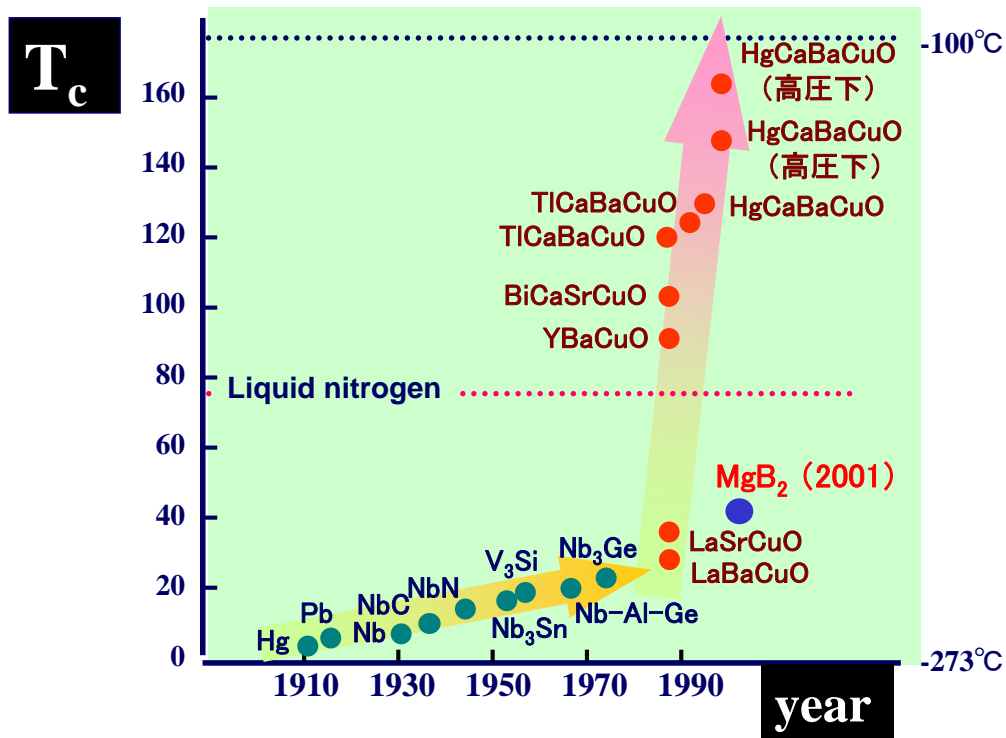
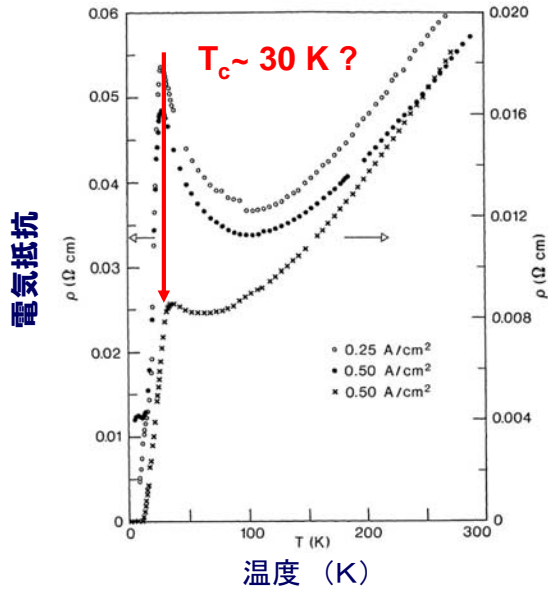


図2 さまざまな現象が起こる温度領域

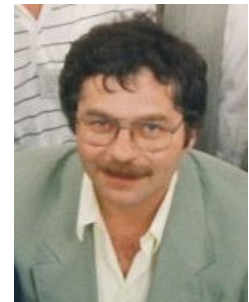
Copper Oxides High- T_c superconductor

“Possible High T_c Superconductivity in the Ba-La-Cu-O System”



Müller

1987 Nobel Prize in Physics

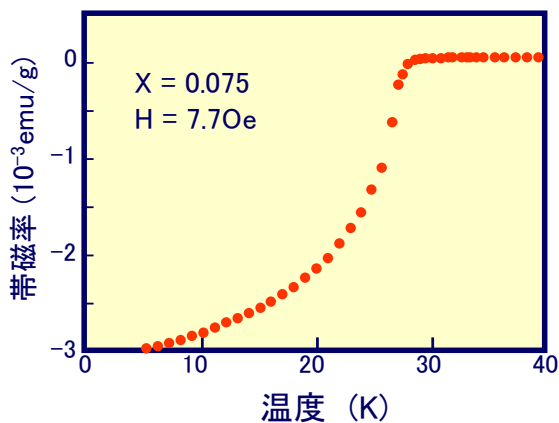


Bednorz

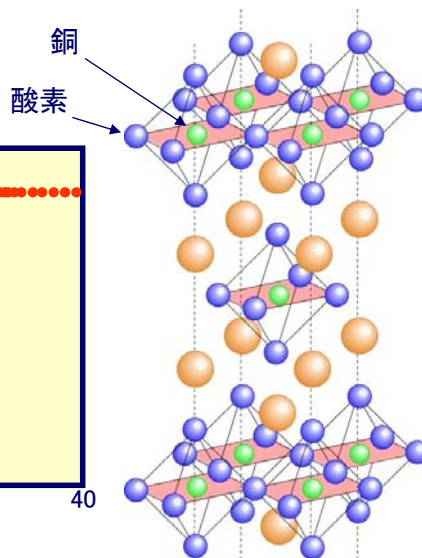
J. G. Bednorz and K. A. Müller, Z. Physik B64, 189 (1986)

“Possible...” → 「確認」!

高温超伝導の確認と構造の決定



マイスナー効果



層状ペロブスカイト
CuO₂ 平面



田中 昭二



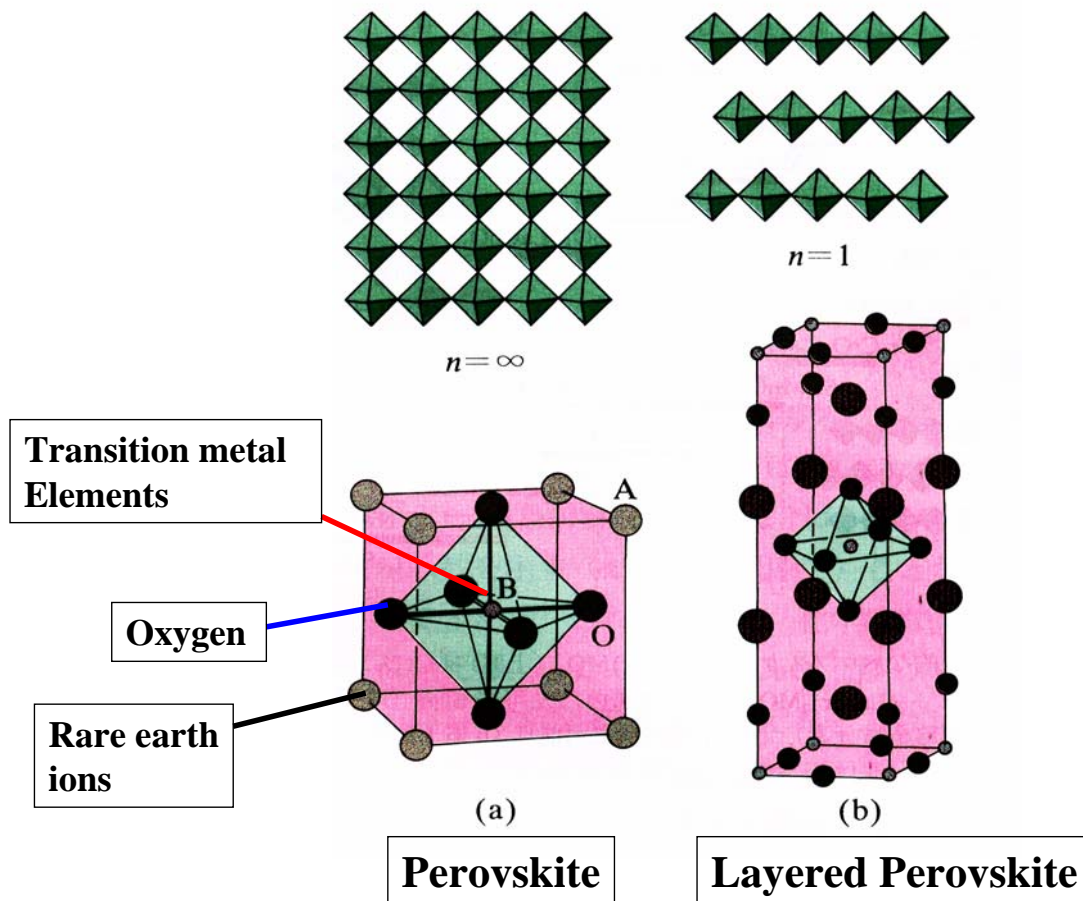
北澤 宏一



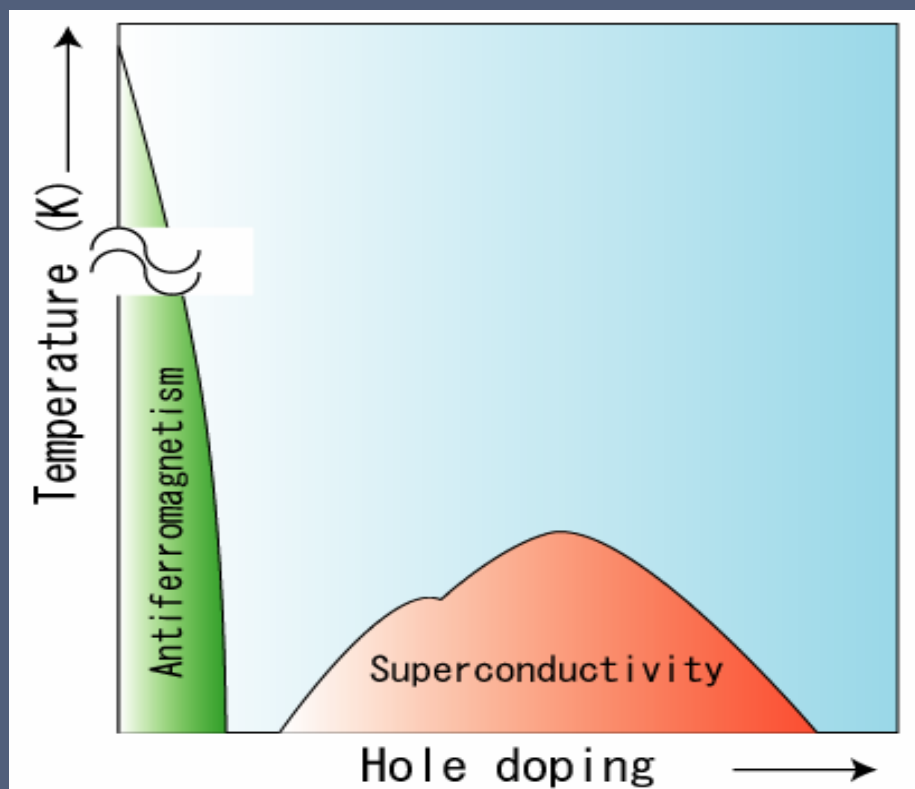
内田 慎一



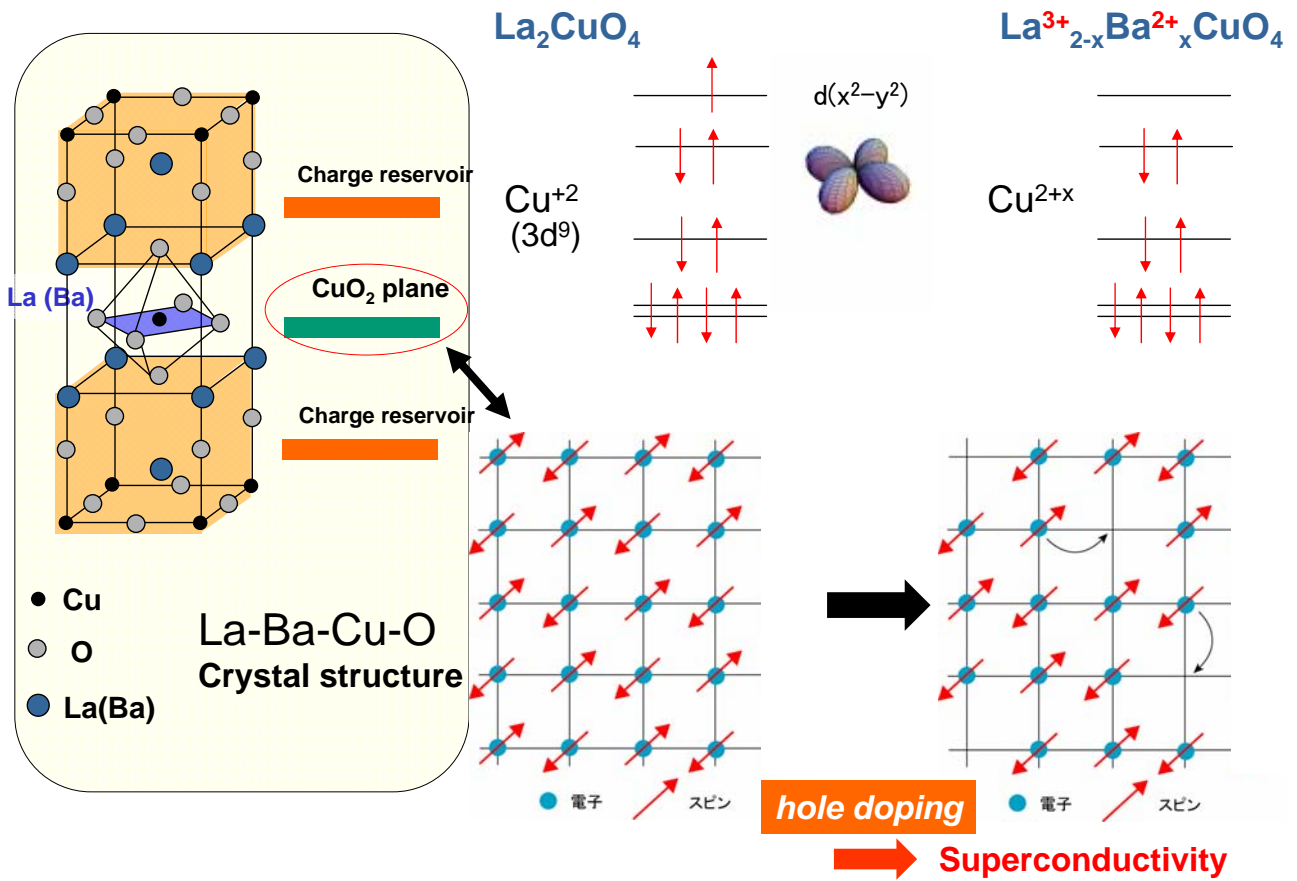
高木 英典



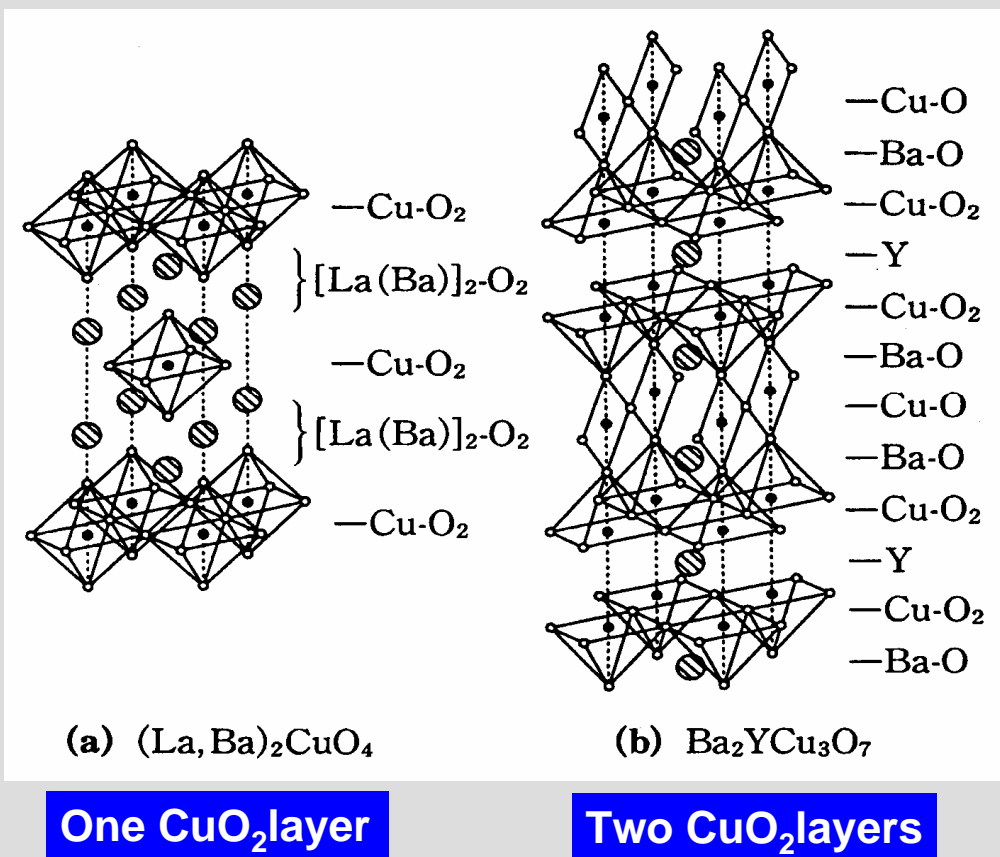
High-temperature superconductivity



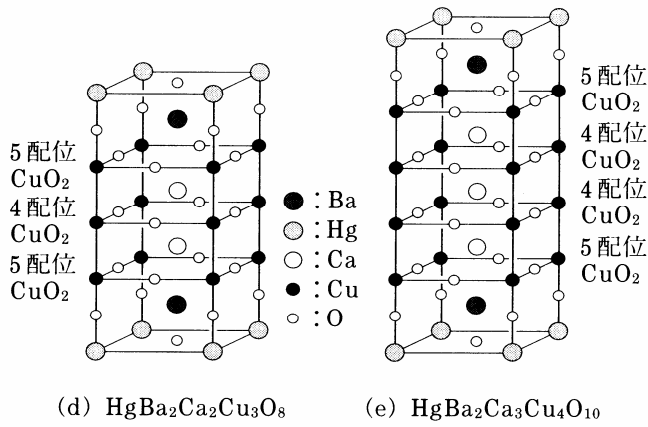
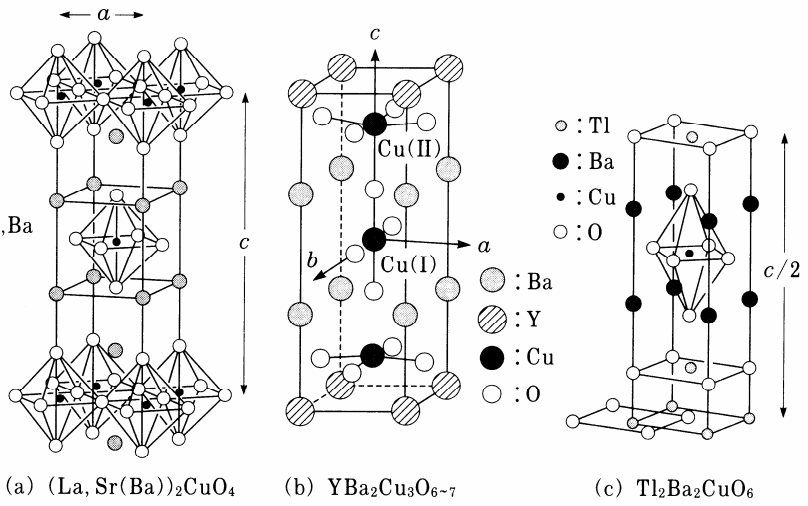
High- T_c Cooper Oxides



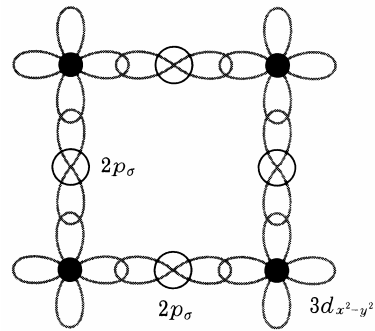
Crystal Structure of High- T_c superconductors



Crystal Structures of Single, Double, Tri-, Four layers HTSC



Electronic Structure of CuO_2 square lattice



List of HTSC compounds

銅酸化物高温超伝導体	超伝導転移温度 (T_c)
$(\text{La, Sr})_2\text{CuO}_4$ (La-214 化合物)	40 K 程度
$\text{YBa}_2\text{Cu}_3\text{O}_7$ (Y-123 化合物)	90 K 程度
$\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$ (Bi-2212 化合物)	90 K 程度
$\text{Bi}_2\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_{10}$ (Bi-2223 化合物)	110 K 程度
$\text{Tl}_2\text{Ba}_2\text{CaCu}_2\text{O}_8$ (Tl-2212 化合物)	100 K 程度
$\text{TlBa}_2\text{Ca}_2\text{Cu}_3\text{O}_9$ (Tl-1223 化合物)	120 K 程度
$\text{Tl}_2\text{Ba}_2\text{Ca}_2\text{Cu}_3\text{O}_{10}$ (Tl-2223 化合物)	120 K 程度
$\text{Tl}_2\text{Ba}_2\text{CuO}_6$ (Tl-2201 化合物)	80 K 程度
$(\text{Nd, Ce})_2\text{CuO}_4$ (Nd-214 化合物)	30 K 程度
$\text{YBa}_2\text{Cu}_4\text{O}_8$ (Y-1248 化合物)	80 K 程度
$\text{Hg}_2\text{Ba}_2\text{Ca}_2\text{Cu}_3\text{O}_{10}$	135 K 程度



^{205}Tl NMR

^{63}Cu

$T_c \sim 90 \sim 80 K$

$T_c \sim 93 K$

$T_c \sim 120 - 135 K$

- Tl
- Ba
- Cu

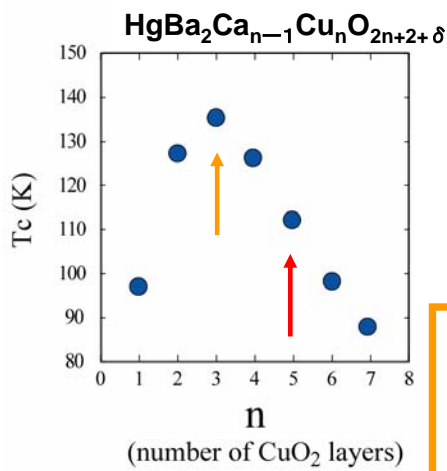
$T_c = 0 \sim 85 K$
Single CuO_2 layer

2201

2212

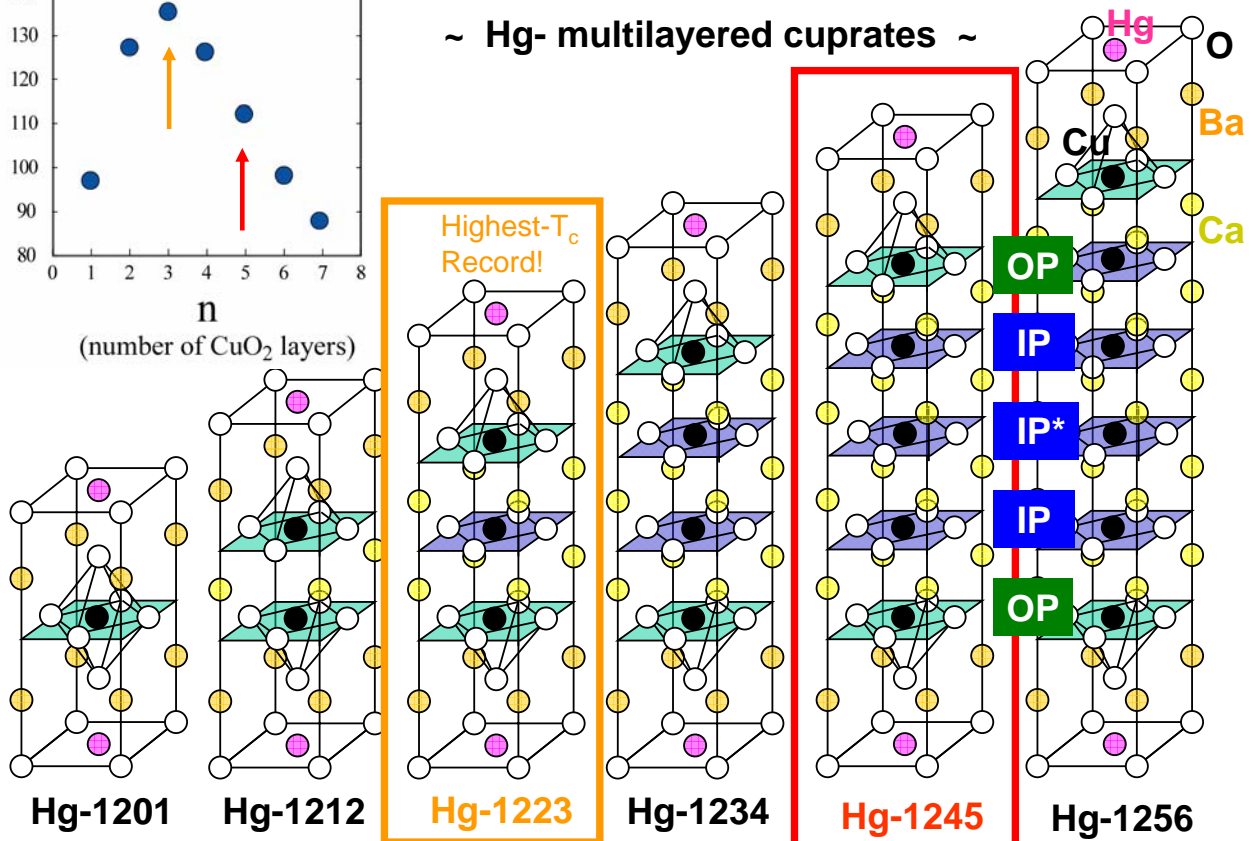
2223

S.S.P. Parkin et al.

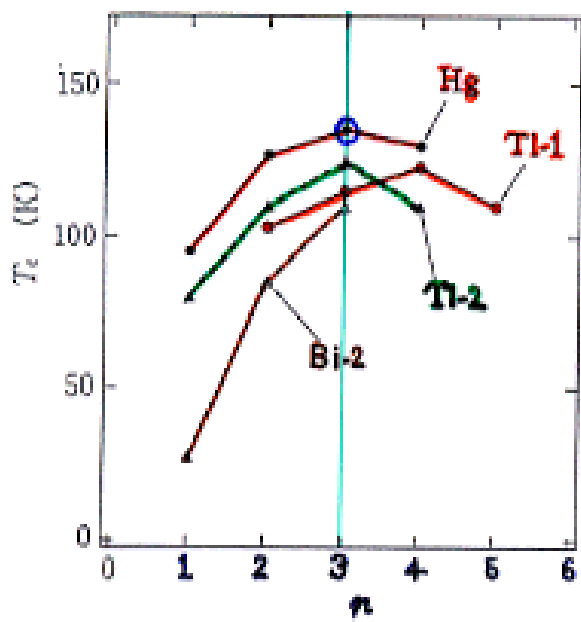


Crystal Structures

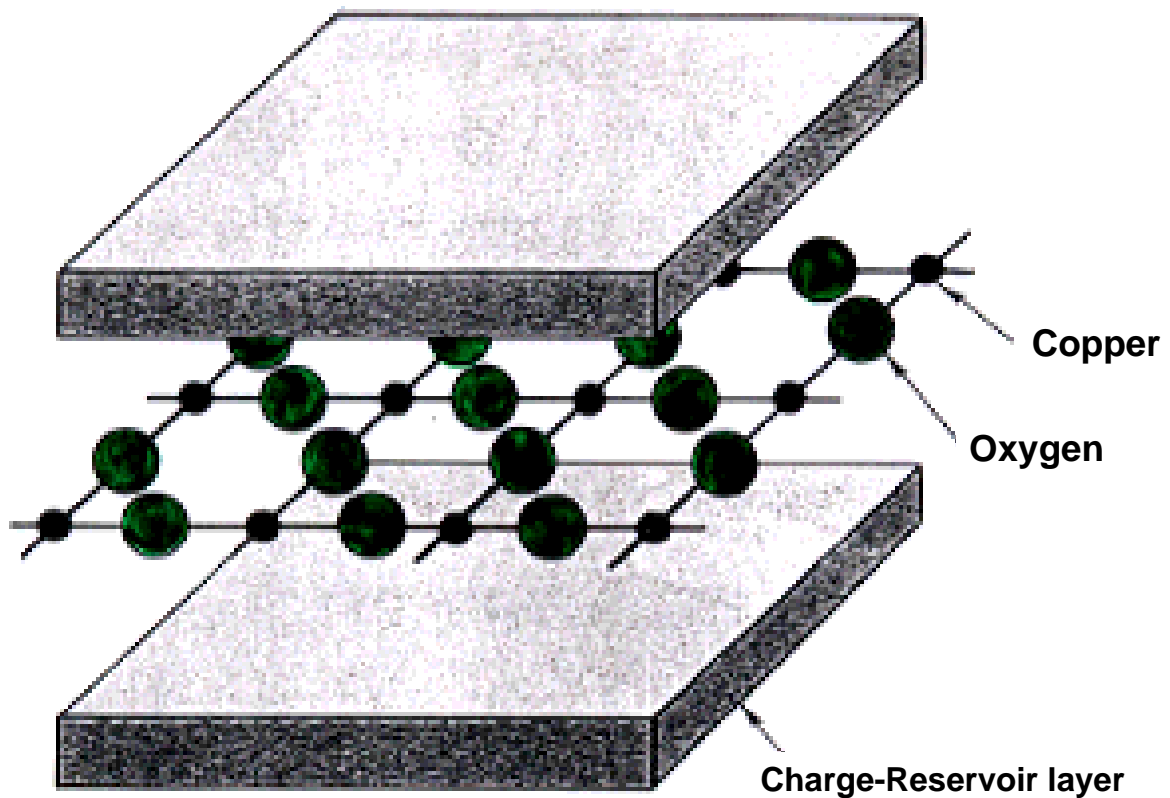
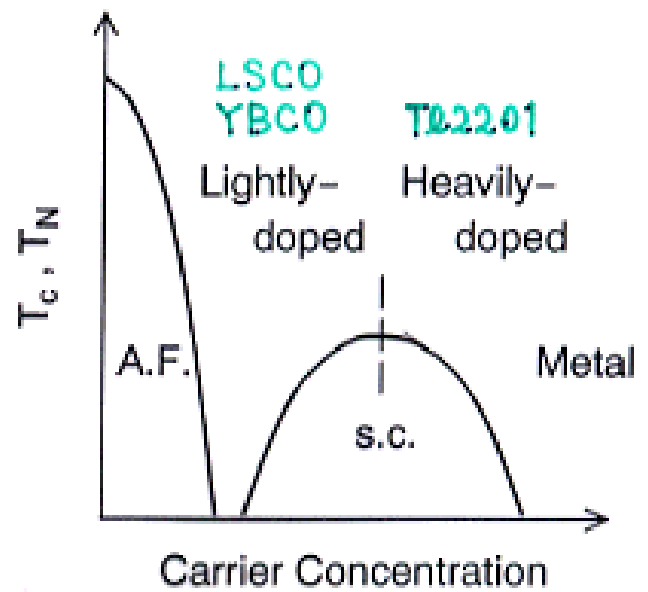
~ Hg-multilayered cuprates ~



T_c dependence of a number of CuO_2 layers and Carrier doping



Number of CuO_2 planes



Structure Unit of layered Copper oxides

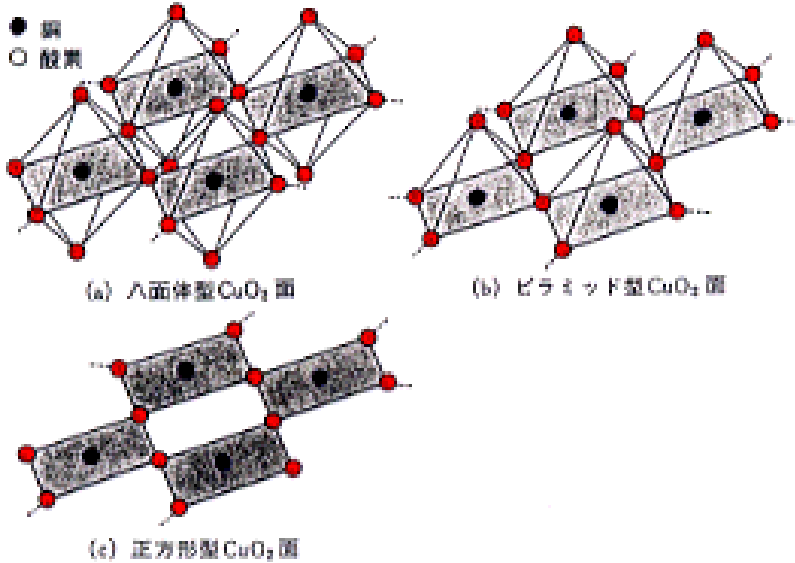


図2 銅酸化物超伝導体 CuO_2 面の三つの結晶構造

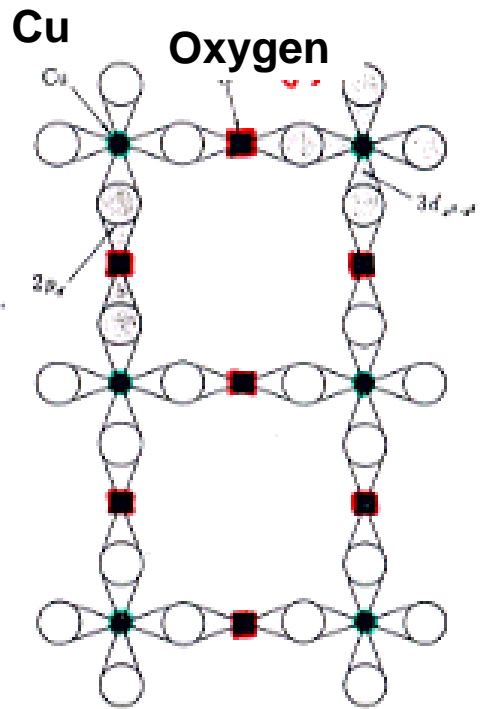
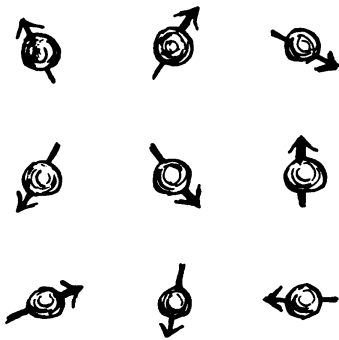


図3 銅の $3d_{x^2-y^2}$ 軌道と酸素の $2p_x$ 軌道の混成を示す CuO_2 面のネットワーク

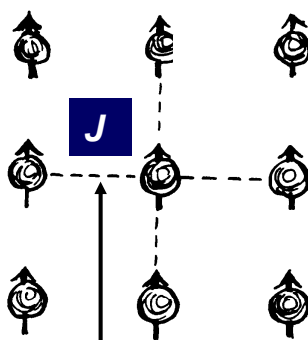
Concept for Magnetism

Paramagnetism



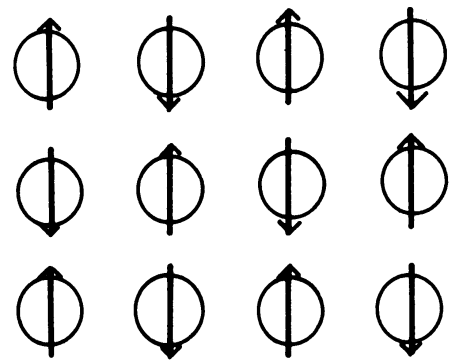
(a)

Ferromagnetism



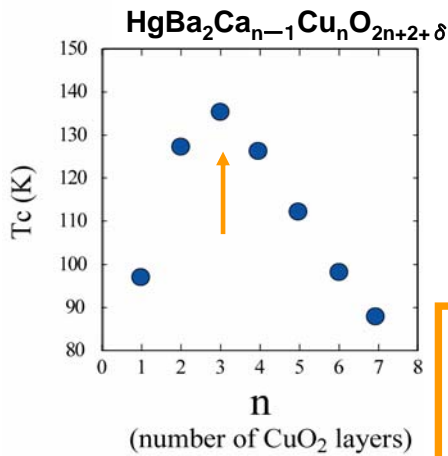
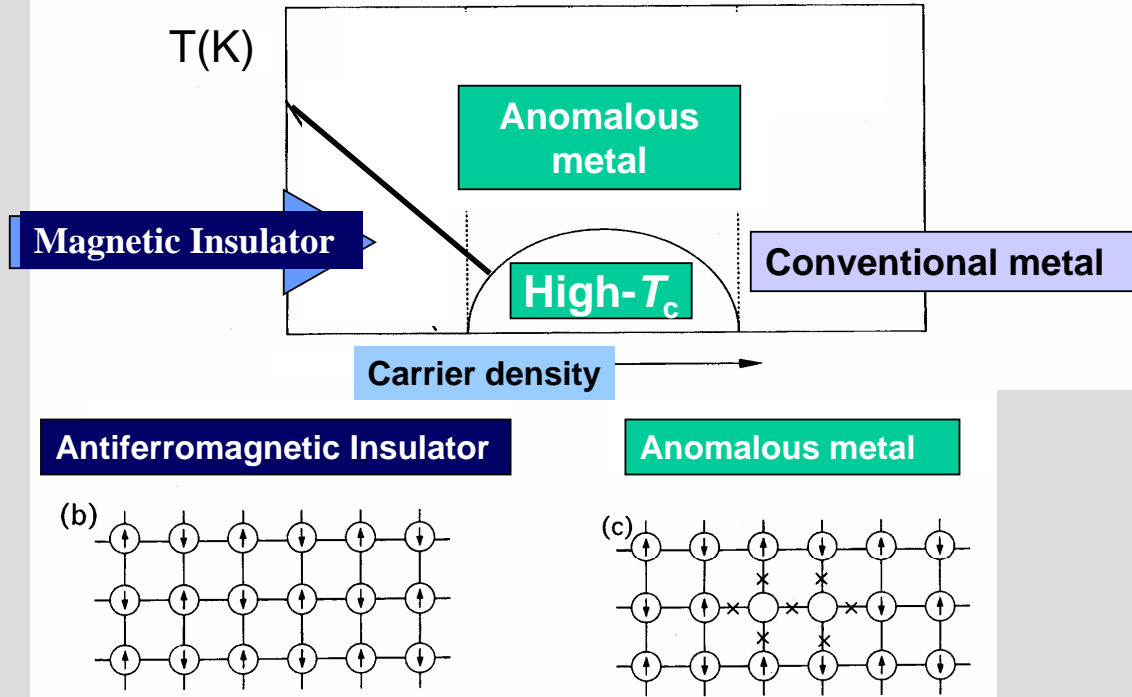
(b)

Antiferromagnetism



magnetic interaction
due to quantum effect

High-temperature superconducting copper oxides via carrier doping into magnetic insulator



Multilayered High- T_c Cuprates

~ Hg-based cuprates ~

