

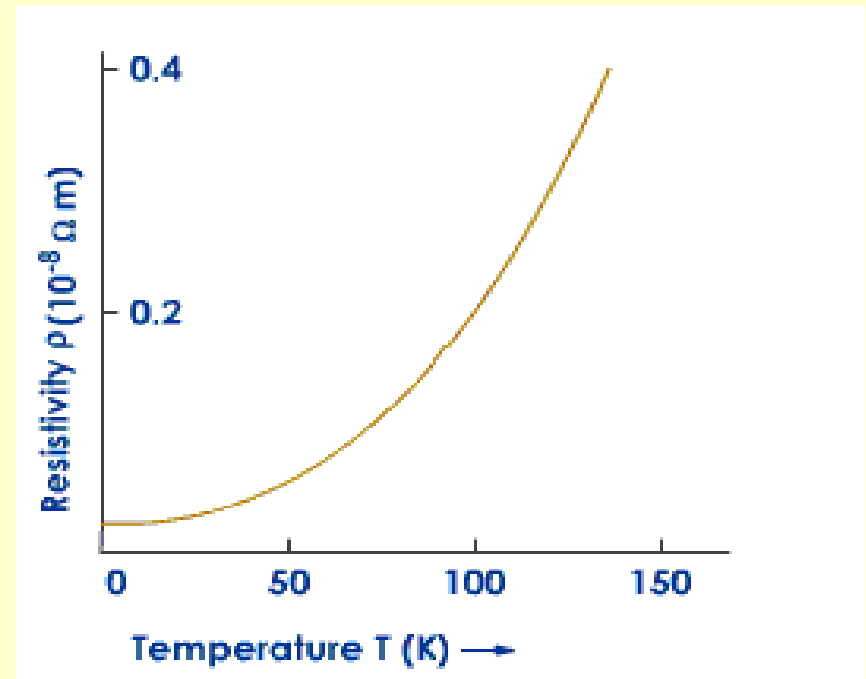
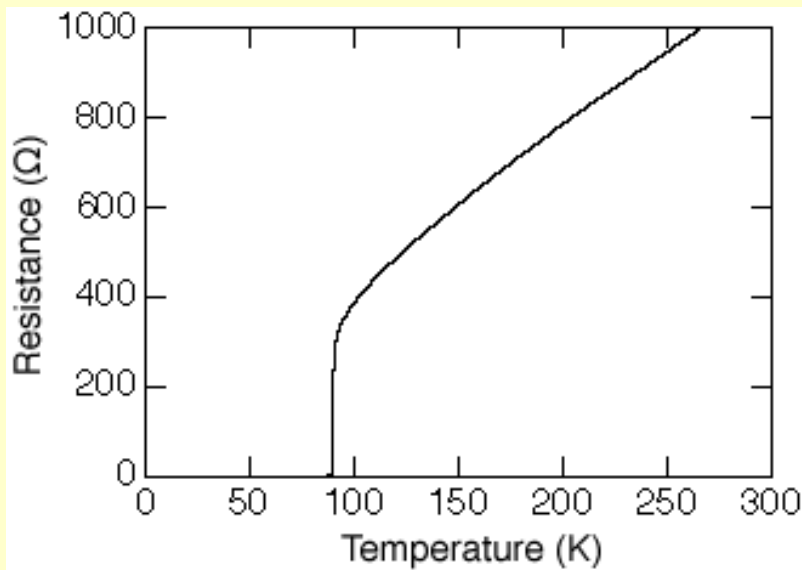
**Fluctuation Induced Conductivity of light, medium and heavy ion
irradiated $\text{Cu}_{0.5}\text{Tl}_{0.5}\text{Ba}_2\text{Ca}_1\text{Cu}_2\text{O}_{8-\delta}$ ($\text{Cu}_{0.5}\text{Tl}_{0.5}$ -1212)
superconductor**

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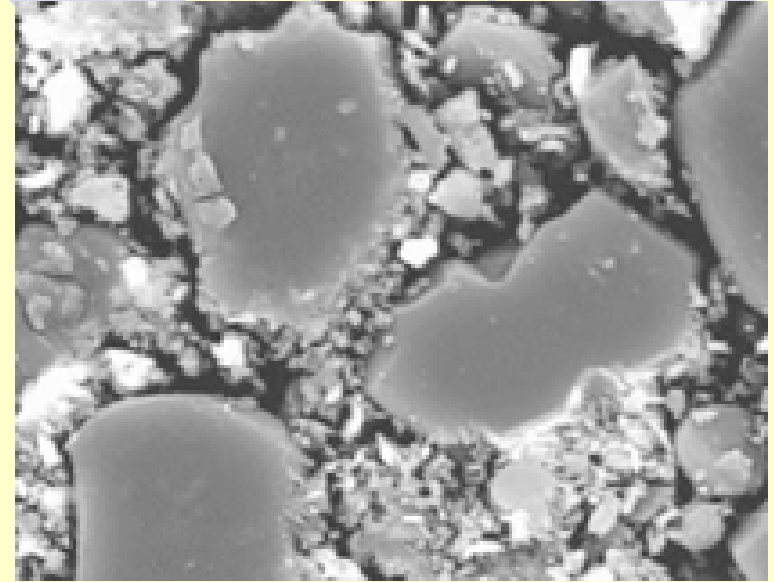
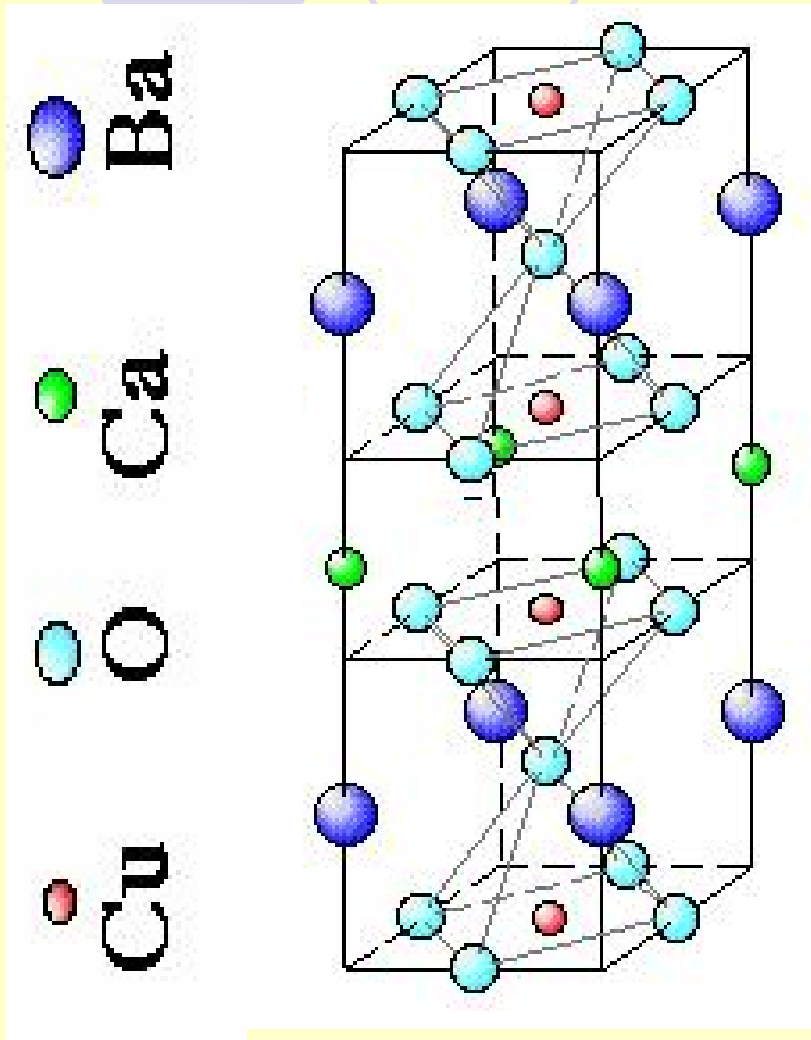
Experimental Physics Labs

What is a Superconductor?

A superconductor is mainly characterized by zero electrical resistance state



Structure of High T_c superconductors



Mostly prepared in the polycrystalline form.



Applications of ion irradiation of superconductors

Strong Flux Pinning



Higher Critical Current Density

Ion irradiation of $\text{Cu}_{0.5}\text{Tl}_{0.5}$ -1212 superconductor

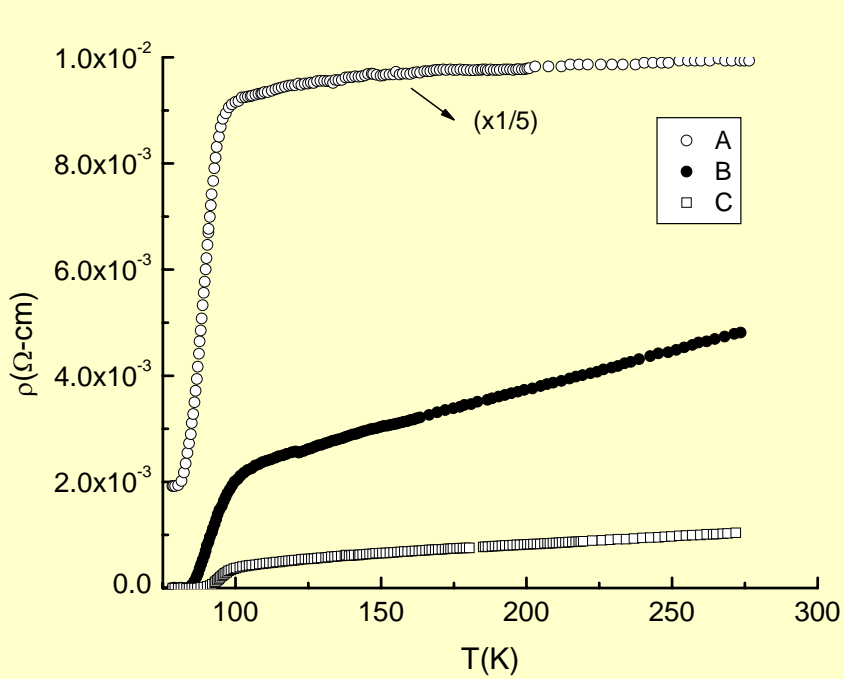
Hydrogen \longrightarrow **6 MeV**

Silicon \longrightarrow **20 MeV**

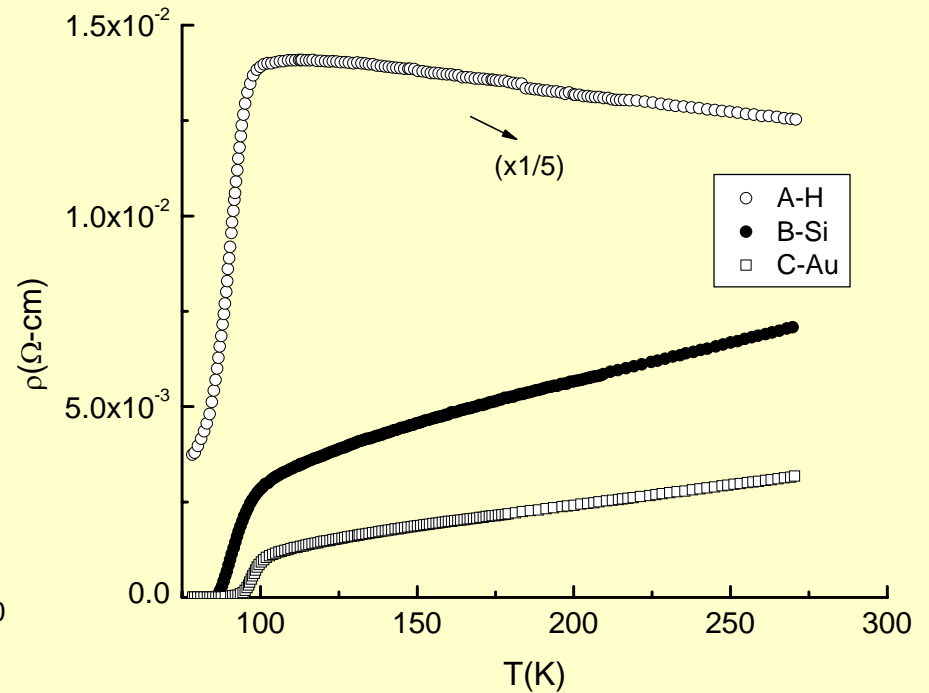
Gold \longrightarrow **20 MeV**

Ion beam	E(MeV)	R(μm)	Sn(MeV/mg/cm ²)	Se(MeV/mg/cm ²)
H	6	267.78	1.952×10^{-5}	3.711×10^{-2}
Si	20	8.23	2.314×10^{-2}	9.584
Au	20	5.04	2.449	8.33

Resistivity Measurements



Resistivity measurements of un-irradiated samples.



Resistivity measurements of irradiated samples.

Fluctuation Induced Conductivity (FIC)

The FIC analysis are used to study the dimensionality of fluctuations of the superconductor order parameter ϕ .

$$|\phi|^2 = n_s$$

Aslamasov-Larkin (AL)

$$\Delta\sigma_{AL} = C_F \varepsilon^{-\alpha}$$

$\alpha=1$ (2D) and $\alpha=0.5$ (3D)

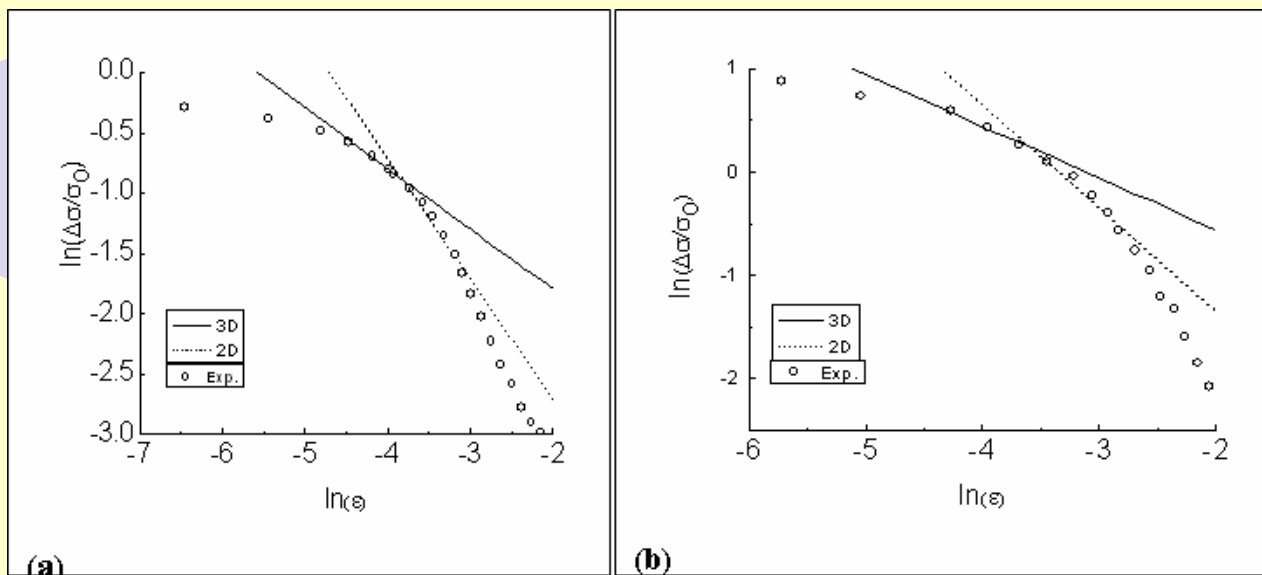
$$\varepsilon = \ln(T/T_c)$$

Lawrence and Doniach (LD)

$$\Delta\sigma_{LD} = C_F \varepsilon^{-1} [1 + (2\xi_c(0)/d)^2]$$

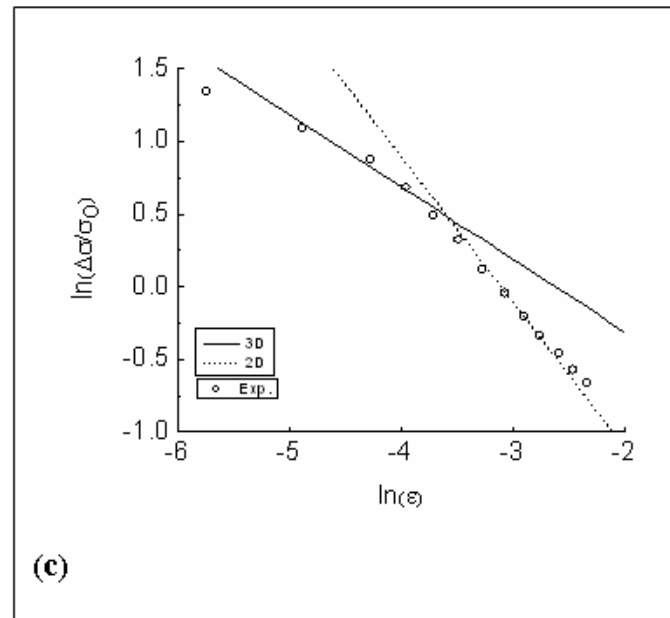
$$\Delta\sigma = (1/\rho) - (1/\rho_n)$$

$$\rho_n = AT + B$$



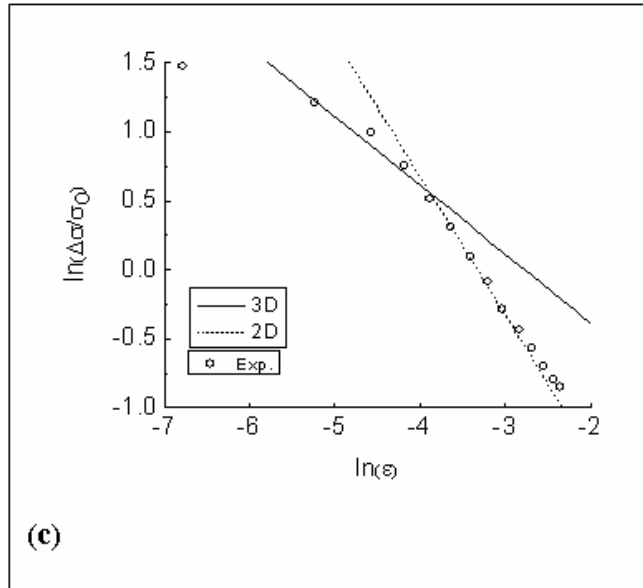
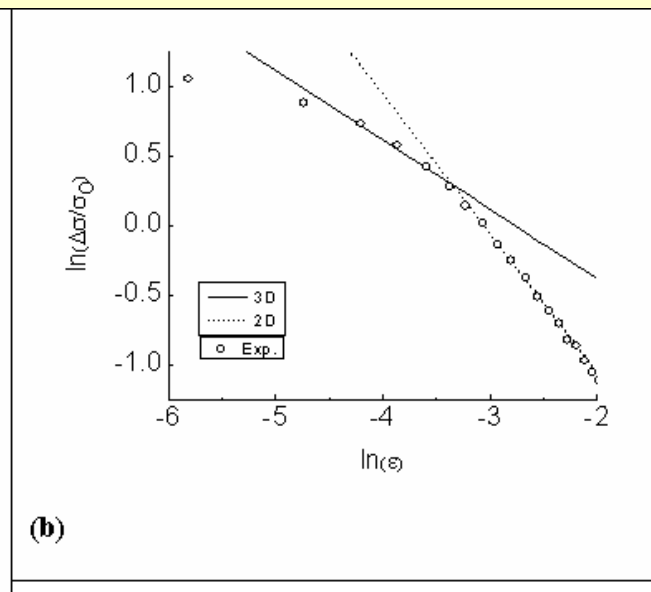
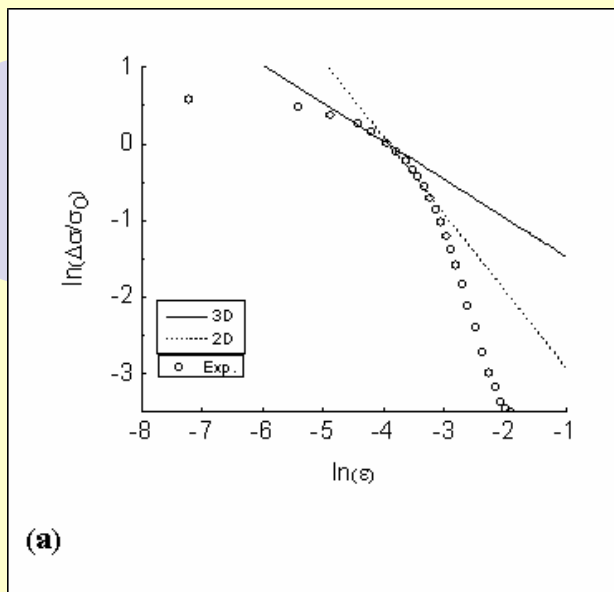
(a)

(b)



(c)

Fluctuation Induced Conductivity analysis of un-irradiated samples



Fluctuation Induced Conductivity analysis of irradiated samples

Un-irradiated samples

	$T_c(0)$	$T_{scf}(K)$	$T_{LD}(K)$	$\rho_{(270K)}$ ($\Omega\text{-cm}$)	$B(\Omega\text{-cm})$
A	<77	95	91	0.05	0.047
B	83.5	105	94	0.005	0.0009
C	86	104	97	0.001	0.0002

Irradiated samples

	$T_c(0)$	$T_{scf}(K)$	$T_{LD}(K)$	$\rho_{(270K)}$ ($\Omega\text{-cm}$)	$B(\Omega\text{-cm})$
A-H	<77	104	92	0.063	0.079
B-Si	85	105	95	0.007	0.0015
C-Au	88	107	100	0.003	0.0003



Conclusions

- The ion irradiations of the $\text{Cu}_{0.5}\text{Tl}_{0.5}\text{Ba}_2\text{Ca}_1\text{Cu}_2\text{O}_{8-\delta}$ superconductor thin films have created damage within the grains as well as in the inter-grain regions.
- The zero resistivity critical temperature depends not only on the nature of the grain boundaries but also on the contributions from the grains.
- $T_c(0)$ has a dependence on the T_{scf} and the 2D-3D cross-over temperature T_{LD} .