# Doping Dependence and High-Pressure Studies on $Eu_xCa_{1-x}Fe_2As_2$

K. Shrestha[1], L. Z. Deng[2], K. Zhao[2], B. I. Jawdat[3], B. Lv[4], B. Lorenz[2], and C. W. Chu[2,5]

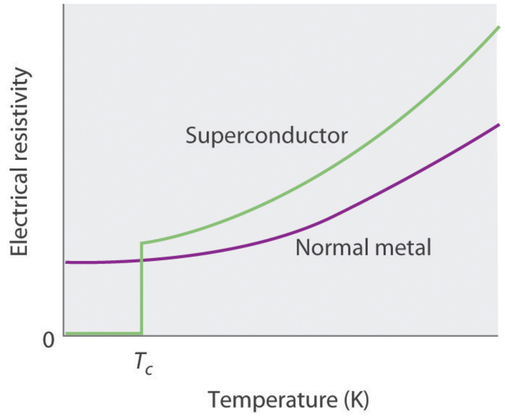
[1]Department of Chemistry and Physics, West Texas A&M University, Canyon, TX, USA; [2]Texas Center for Superconductivity and Department of Physics, University of Houston, Houston, TX, USA; [3]Department of Materials Science and Nano Engineering, Rice University, Houston, TX, USA; [4]Department of Physics, The University of Texas at Dallas, TX, USA ; and [5]Lawrence Berkeley National Laboratory, Berkeley, CA, USA

## What is a superconductor?

The phenomenon of superconductivity, in which the electrical resistance of certain materials completely vanishes at low temperatures, is a fascinating and sophisticated area of condensed matter physics. The temperature at which the resistance goes to zero is called a critical temperature (Tc). Superconductivity was first discovered by the Dutch physicist Heike Kamerlingh Onnes in 2011. Since then, there have been hundreds of new superconductors found with the critical temperature reaching as high as Tc ~ 200 K.

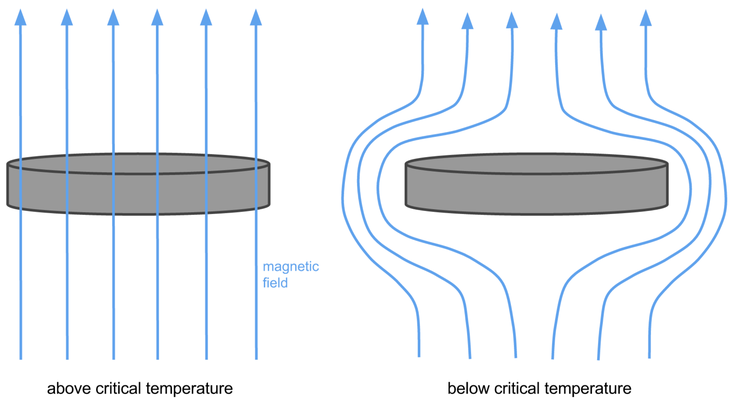
### (1) Zero Electrical Resistance

A superconductor has zero electrical resistance.

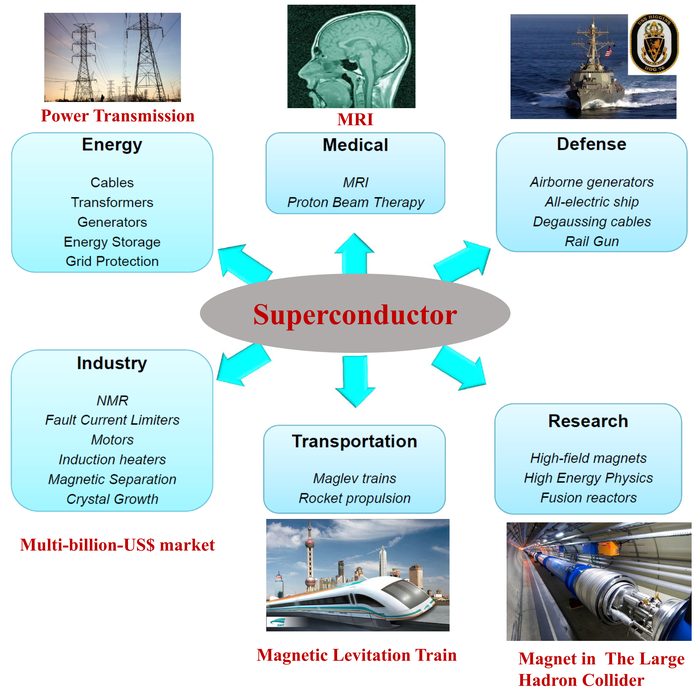



### (2) Repel Magnetic Field

A superconducting material repels magnetic field below $T_c$.




## Why is a superconductor important?

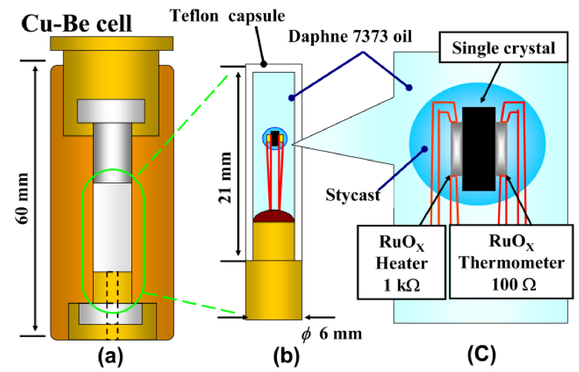



A search of a new kind of material that shows superconductivity at room temperature is important for technological use.

## Objective

Use the high pressure technique to induce superconductivity
- $Eu_xCa_{1-x}Fe2As2$ sample (collaboration with Chemistry)
- Study the pressure-temperature phase diagram

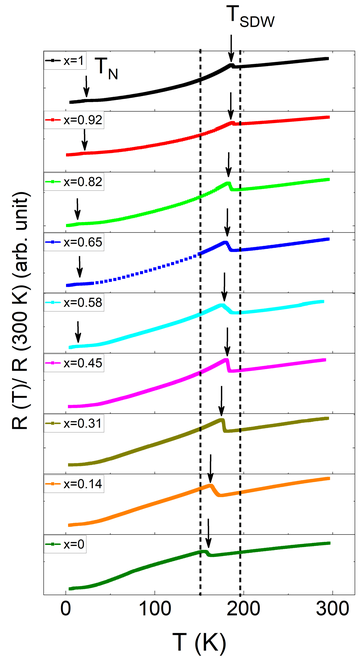
## High-Pressure Technique



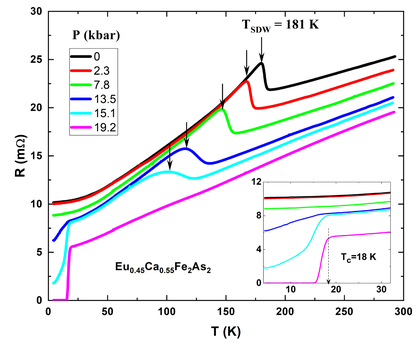

Pressure Range ~ 20 kbar (20,000 × pressure in sea level)

## Results and Discussion

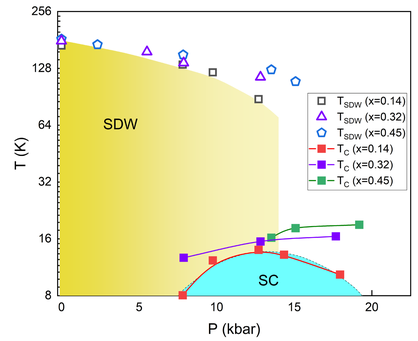
### (1) Resistance versus Temperature




### (2) Resistance Under High-Pressure




### (3) The P-T Phase diagram




Take Home Messages:

- Magnetic transition (Spin-density wave) at high-T
- None of the samples show superconductivity ($R \neq 0$) at ambient pressure.
- Pressure induces superconductivity
- Show an interesting pressure-temperature phase diagram

## Acknowledgements

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