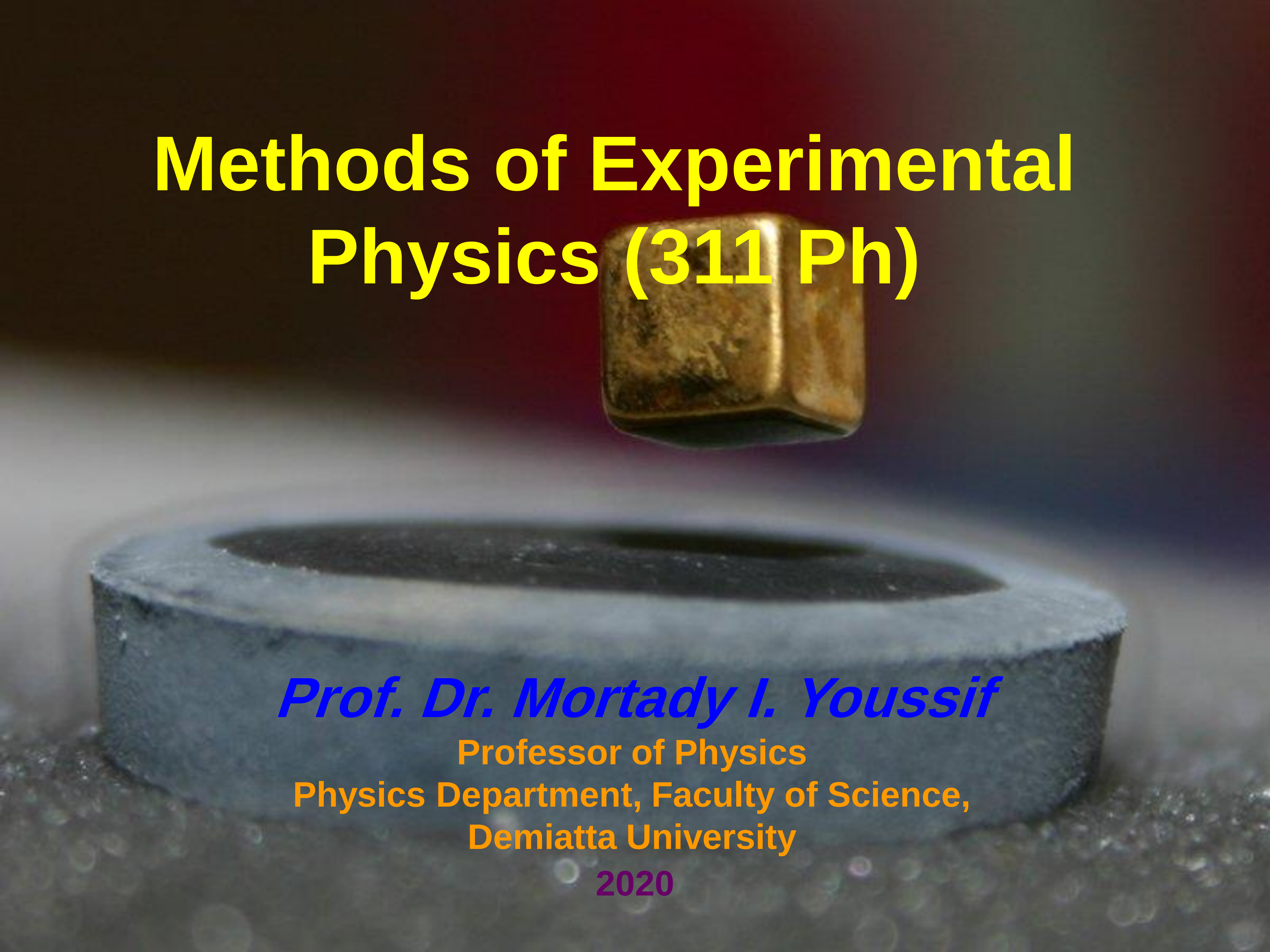

بسم الله الرحمن الرحيم



Methods of Experimental Physics (311 Ph)

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Out line

- Brief Historical Review
- Type I Superconductor
- Type II Superconductor
- High Temperature Superconductivity
- Applications using Superconductors
- Conclusion

Brief Historical Review

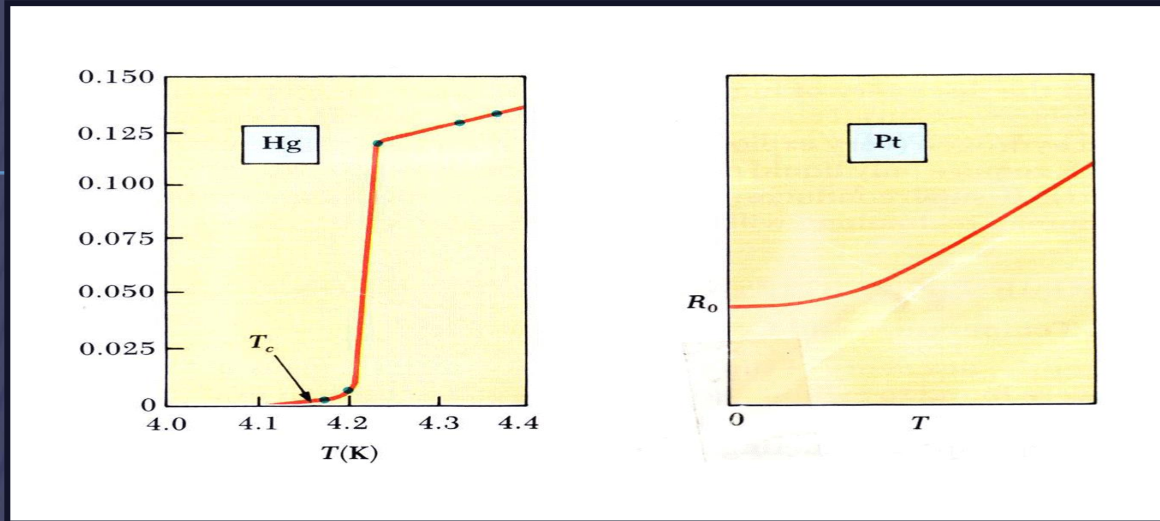
- **The era of low temperature physics began in 1908 when the Dutch physicist H.K. Onnes first liquefied helium, which has boiling temperature of only 4.2 K.**

- **In 1911, Onnes and one of his assistants discovered the phenomenon of superconductivity while studying the resistivity of metals at low temperatures.**

- **They found that the resistivity, when extrapolated to 0 K, depended on the purity of the sample. Then they have decided to study mercury and fount that the resistance of the Hg sample dropped sharply at 4.15 K to unmeasurably small value. They name this new phenomenon of perfect conductivity, superconductivity.**

- **In 1913, Onnes was awarded the Noble prize in physics.**

- **We now know that the resistivity of a superconductor is truly zero.**



❖ **Many other elemental metals were found to exhibit zero resistance when the temperature was lowered below the critical temperature, *T_c*.**

Be 0.03											B	C
Mg											**Al 1.18**	Si
Ca	Sc	**Ti 0.4**	**V 5.4**	Cr	Mn	Fe	Co	Ni	Cu	**Zn 0.85**	**Ga 1.08**	Ge
Sr	Y	**Zr 0.81**	**Nb 9.25**	**Mo 0.92**	**Tc 7.8**	**Ru 0.49**	Rh	Pd	Ag	**Cd 0.52**	**In 3.4**	**Sn 3.72**
Ba	**La 6.0**	**Hf 0.13**	**Ta 4.47**	**W 0.02**	**Re 1.70**	**Os 0.66**	Ir	Pt	Au	**Hg 4.15**	**Tl 2.38**	**Pb 7.19**
Ra	Ac	**Th 1.38**	**Pa 1.4**	**U 0.25**								

- **In 1933, Meissner and Ochsenfeld studied the magnetic behavior of superconductors in the presence of a magnetic field and found that the magnetic flux is expelled from the interior of the superconductor when it cooled below T_c.**

- **In 1935, Fritz and Heinz London developed a phenomenological theory of superconductivity.**

- **In 1957, Bardeen, Cooper and Schrieffer (BCS-theory) explained the actual nature and origin of the superconducting state. A central feature of this theory is the formation of bound two-electron states called cooper pairs.**

- **In 1962, Brian D. Josephson predicted a tunneling current between two superconductors separated by a thin (< 2mm) insulating barrier, where the current is carried by these paired electrons (Josephson effect).**

- **Early in 1986, J. Georg Bednorz and Karl Alex Muller reported evidence for superconductivity in an oxide of lanthanum, barium, and copper at a temperature of about 30 K. This was a major breakthrough in superconductivity which marks the beginning of a new era of High-Temperature Superconductivity since the highest known value of T_c at that time was about 23 K in a compound of niobium and germanium.**

- **Recently, researchers have reported critical temperature as high as 125 K in more complex metallic oxides, but the mechanisms responsible for superconductivity in these materials remain unclear up till now.**

- **In 1987, Bednorz and Muller were awarded the Noble prize in physics.**

- **If superconductors with T_c's above room temperature are ever found, human technology will be drastically altered.**

History of superconductivity