Condensed Matter Physics

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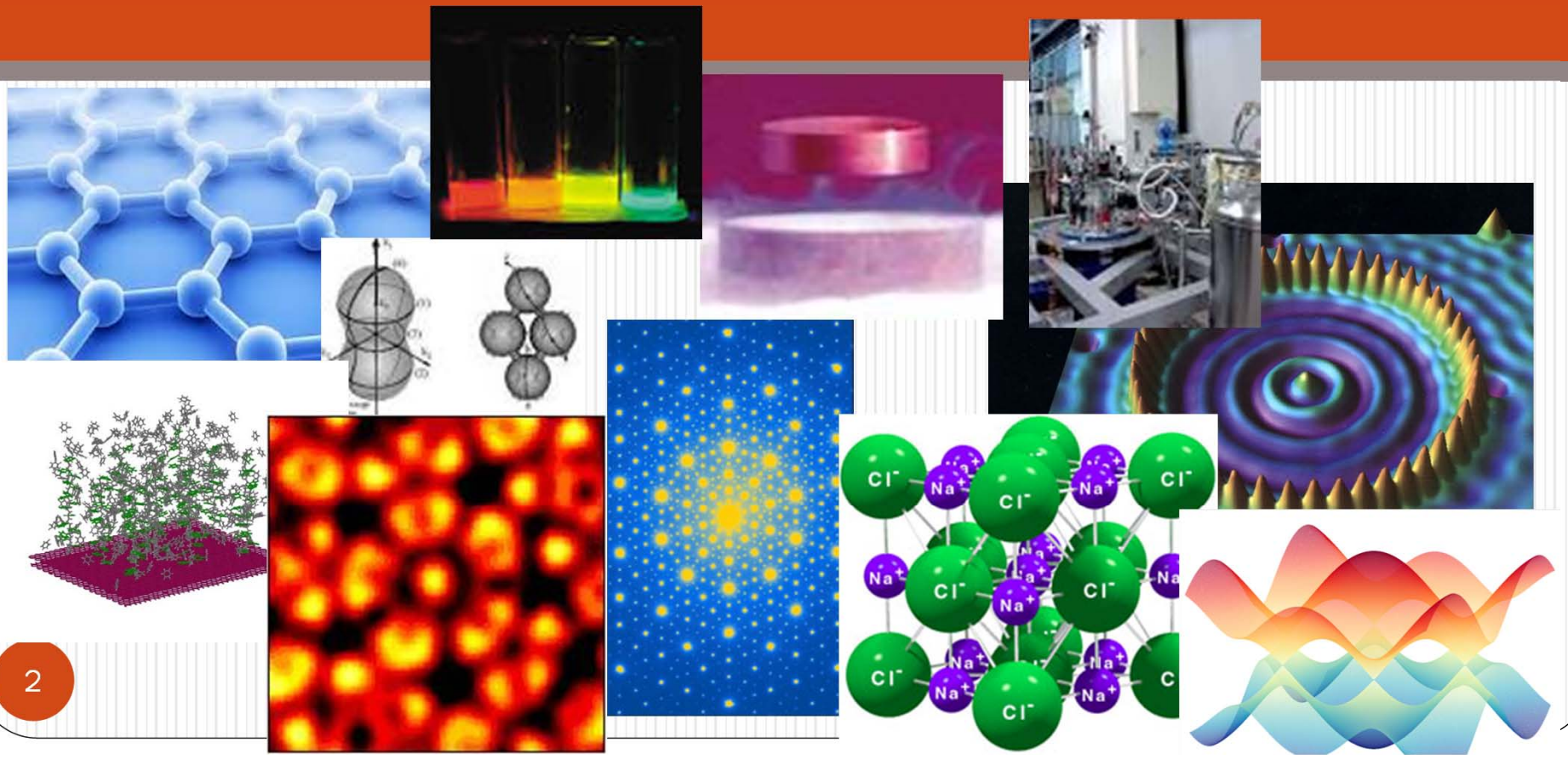
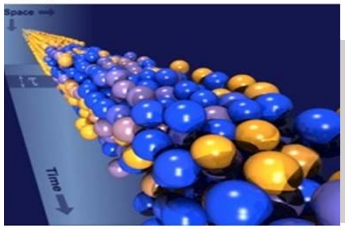
Condensed Matter Physics



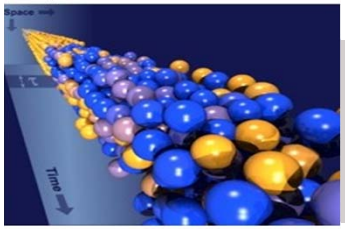


What is Condensed Matter Physics?

- **Condensed matter physics** is the **fundamental science** of solids and liquids.

- **Condensed matter physics** deals with the physical properties of condensed phases of matter. Condensed matter physicists seek to understand the behavior of these phases by using physical laws. In particular, these include the laws of **quantum mechanics**, **electromagnetism** and **statistical mechanics**.

- **Condensed matter physics** deals with fundamental questions concerning the behavior of **very large numbers of** strongly interacting degrees of freedom.

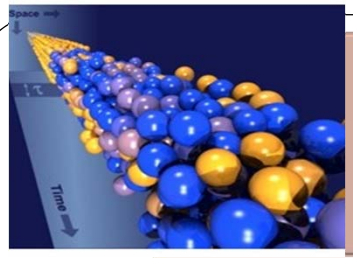


What is Condensed Matter Physics?

- **Condensed matter physics is the science that deals with the structures, properties and fundamental laws of condensed matter. It is connecting atomic-scale physics to the properties of macroscopic systems.The essence of the subject can be revealed in ten words:**

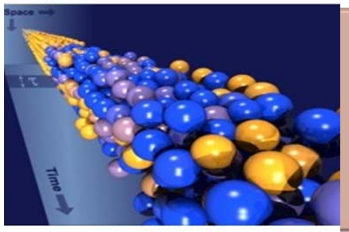
"The whole is more than the sum of its parts."

- **The creation and study of new materials is a central goal of condensed matter physics .**



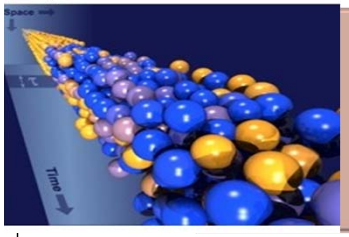
History

- **Quantum Mechanics**
- **Metals Physics**
- **Solid State Physics (with creation of the Division of Solid State Physics by APS in 1947)**
- **Journal : *"Physics of condensed matter"* in 1963**
- **The research group in the Cavendish Laboratory of the University of Cambridge was renamed from "Solid-State Theory" to "Theory of Condensed Matter" in 1967**
- **APS Division of Solid State Physics voted to change its name to the Division of Condensed Matter Physics in April 1978**

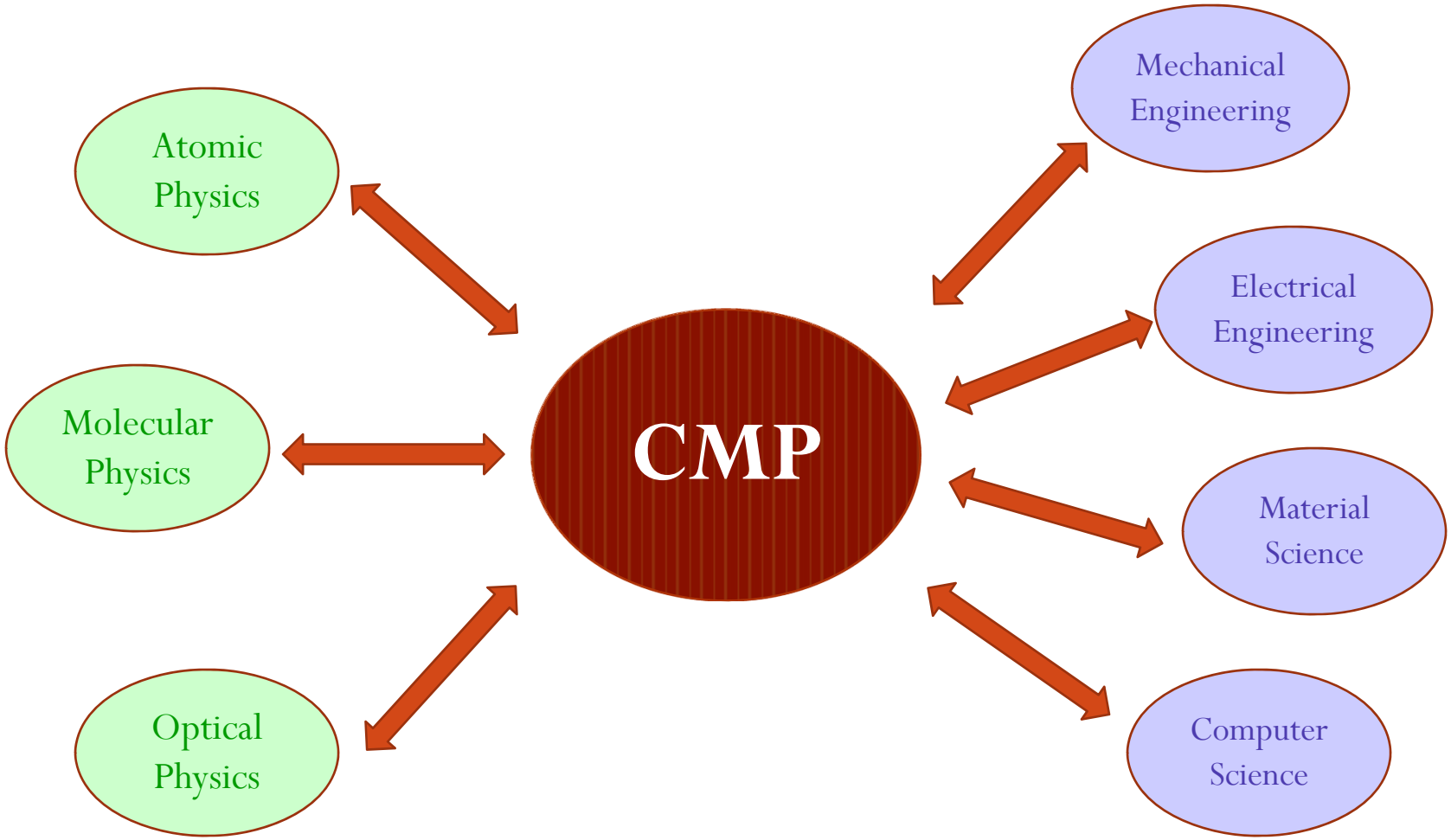


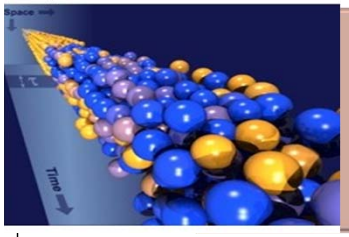
Condensed Matter Physics (CMP)

- The largest branch of physics
- It includes a wide range of topics
- It has greatest impact on our daily lives by providing foundations for technology developments
- Over the past 50 years, 22 Nobel Prizes in Physics were awarded to CMP and related areas, and 5 Nobel Prizes in Chemistry were awarded for subjects in CMP.
- One third of all United States Physicists identify themselves as condensed matter physicists.
- The Division of Condensed Matter Physics (DCMP) is the largest division of the APS
- CMP has a large overlap with chemistry, material science, and nanotechnology.
- Marvin L. Cohen: "In some sense, physics is the central science. ..Within physics, CMP is central in this sense."



Condensed Matter Physics (CMP)





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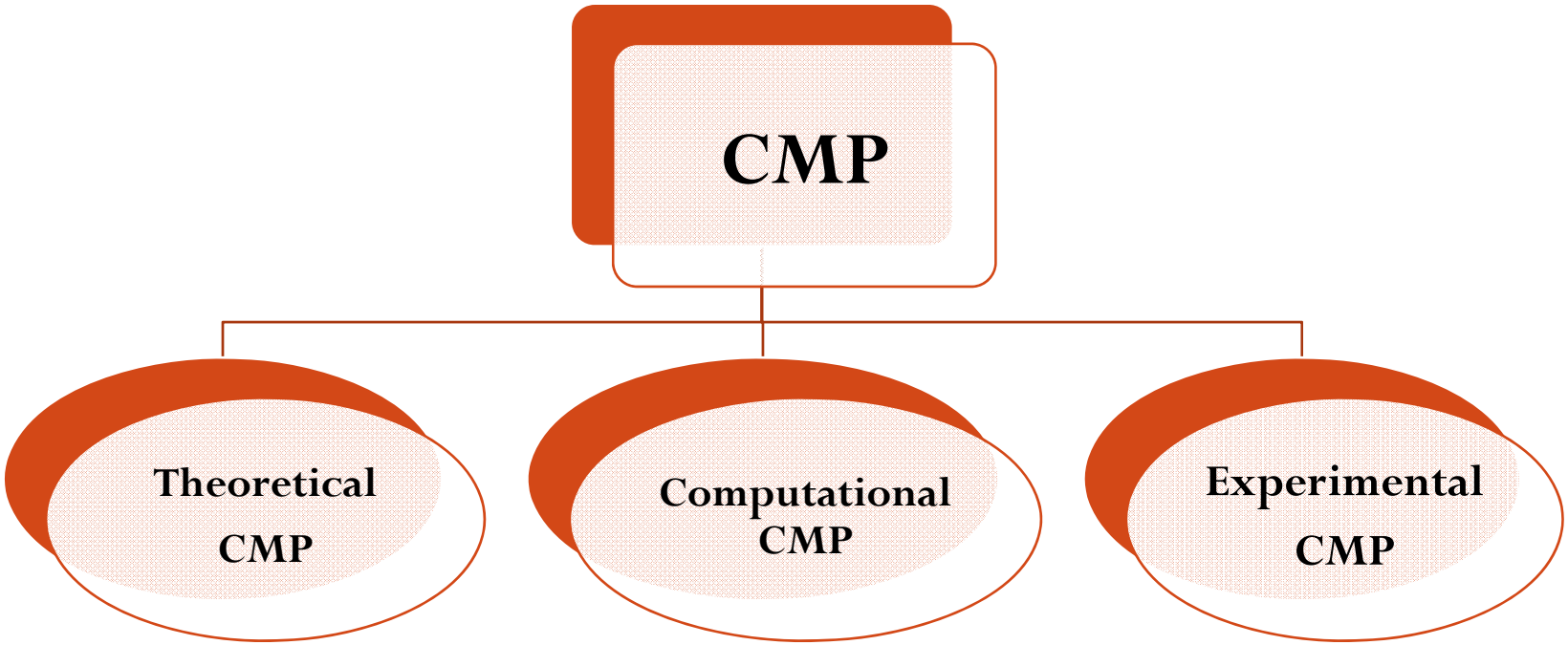
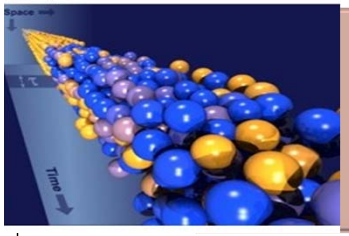




Condensed Matter Physics (CMP)

CMP

Bulk & Nanostructures

Hard CMP

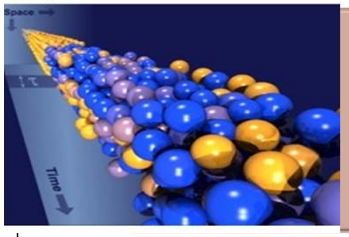
Crystalline solids
Metals, Semiconductors, Insulators

Non-Crystalline solids
Amorphous, Polymers

Soft CMP

Colloids, Gels, Liquid crystals

Biological systems



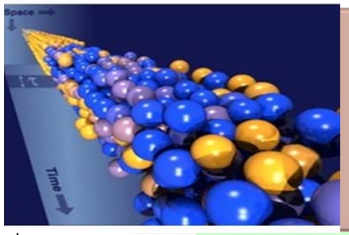
Condensed Matter Physics

Some Condensed Phases

- Solids
- Liquids
- Superconductivity
- Superfluidity
- Ferromagnet & Anti ferromagnet
- …

Some Properties

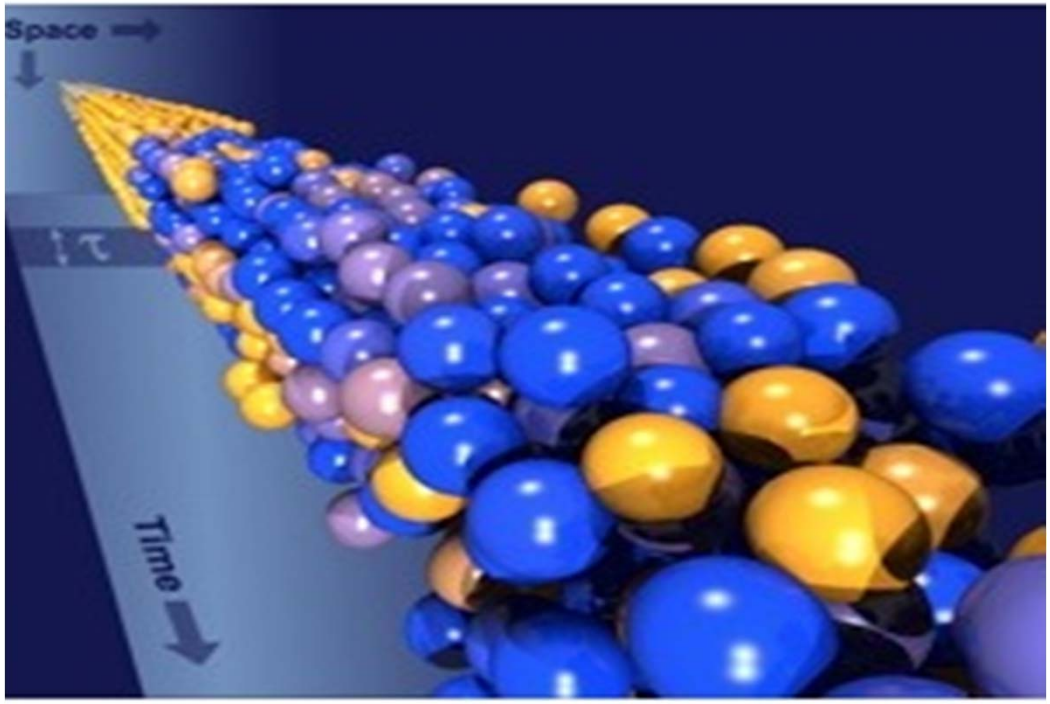
- Many-body Properties
- Structural Properties
- Electrical Properties
- Thermal Properties
- Optical Properties
- Mechanical Properties
- Magnetic Properties
- …



Condensed Matter Physics (CMP)

Many technological applications

- **Semiconductor transistors, mirco and nano electronics**
- **Solid state lasers**
- **Magnetic memory storage**
- **Liquid crystal displays**
- **Ultra-sensitive superconducting magnetometers (called SQUIDS) for mapping brain activity**
- **Nuclear magnetic resonance imaging for medical screening and analysis**
- **Nanotechnology**
- **Scanning Probe Microscopy (SPM)**
- **Spintronic devices**
- **Biosensors**
- …



Thank you for your attention