

Methodology and perspective of Physics

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Brief History of Physics During the Last Century

- **Most significant scientific developments in 20th century**

- General Relativity
- Big Bang cosmology
- Quantum mechanics
- Unraveling of the genetic code
- Evolutionary biology

- **Quantum mechanics is unique**

- It explains the behavior of matter and its interactions with energy on the scale of atoms and subatomic particles
- **It forced** physicists **to** reshape their ideas of reality,
- **to** revise their concepts of position and speed,
- **to** revise their notion of cause and effect

- **Without quantum mechanics we would not have electronic revolution and computers.**

- Computers need semiconductor devices
- The whole theory (band structures, doping, etc) is based on a foundation of quantum mechanics

Einstein's Love-Hate Relationship with Quantum Physics

- Einstein received the Nobel Prize in Physics in 1921 for explaining Photoelectric effect
- discrete packages of energy-quanta.
- The idea of the quanta of light give rise to the development of quantum physics.

- But, Einstein maintained a strange relationship of suspicion toward this vibrant new field (Quantum physics)

"I am convinced that God does not play dice" - Einstein

All the fifty years of conscious brooding have brought me no closer to answer the question, "What are light quanta?"

Of course today every rascal thinks he knows the answer, but he is deluding himself.

-Einstein

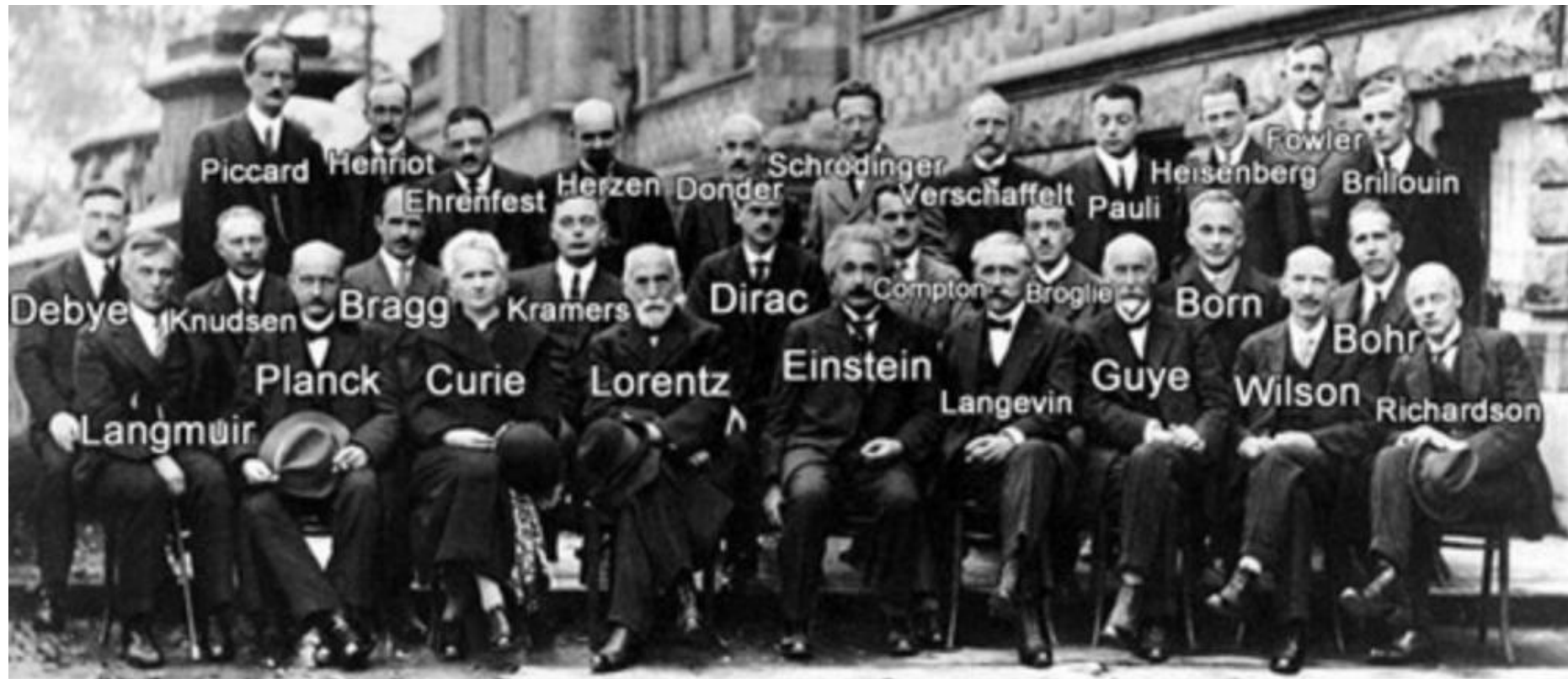
"I think it is safe to say that no one understands quantum mechanics."

—Richard P. Feynman

Fifth Solvay International Conference on Electrons & Photons, (October 1927)

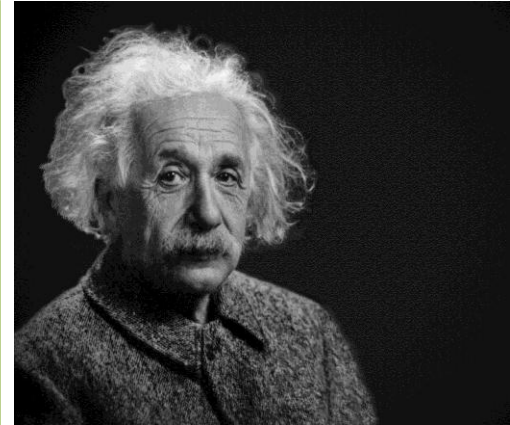


Solvay Conference 1927



'Annus Mirabilis'

- Annus mirabilis (~Latin)- means **extraordinary year**
- The *Annus mirabilis papers* are the papers of **Albert Einstein** published in the *Annalen der Physik* scientific journal in **1905**
- The annus mirabilis is often called the "**miracle year**"
- Einstein completed **six** papers in **1905**.
- **Four** of the papers were published in **1905** and the other two in **1906**
- These four articles contributed substantially to the foundation of **modern physics** and changed views on **space, time, mass, and energy**.



Einstein's FOUR papers published in 1905

| | Paper Name | Discussion |
|---|--|---|
| 1 | On a Heuristic Point of View Concerning the Production and Transformation of Light | Light quanta & Photoelectric effects |
| 2 | On the Motion of Small Particles Suspended in Liquids at Rest Required by the Molecular-Kinetic Theory of Heat | Brownian motion -agitated random motion of particles suspended in a liquid |
| 3 | Does the Inertia of a Body Depend on Its Energy Content? | special relativity & preliminary version $E=mc^2$. |
| 4 | On the Electrodynamics of Moving Bodies | Relation ship between time & space |

Einstein's TWO papers published in 1906

| | Paper Name | Discussion |
|---|---|--|
| 5 | A New Determination of Molecular Dimensions | Determination of molecular sizes & Avagadro's number |
| 6 | On the Theory of Brownian Motion | second paper on Brownian motion |