

UPSC IAS 2023/2024



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THE ECONOMIC TIMES

GS - III - SCIENCE & TECHNOLOGY

366

NOBEL PHYSICS FOR ATTOSCOND
PULSES OF LIGHT & CHEMISTRY
FOR QUANTUM DOTS



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GS - III - SCIENCE & TECHNOLOGY

Science and Technology - developments and their applications and effects in everyday life Achievements of Indians in science & technology; indigenization of technology and developing new technology.

NEWS ARTICLE FOR REFERENCE

- “Inspiring colours” – The Hindu – 6th October, 2023

PROBABLE QUESTION

What do you understand by Quantum Dots? What are their modern-day applications?

KEY WORDS

- Nobel Physics
- Nobel Chemistry
- Quantum Dots
- Attoseconds
- Nano Particles
- LEDs
- Television Screens

NOBEL PRIZE 2023 IN PHYSICS AWARDED TO THREE SCIENTISTS

- The 2023 Nobel Prize in Physics has been awarded to Pierre Agostini, Ferenc Krausz and Anne L’Huillier for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter.
- An attosecond is so short that there are as many in one second as there have been seconds since the birth of the universe. The brief pulses of light can be used to provide images of what occurs inside atoms and molecules.
- These three scientists have demonstrated a way to create extremely short pulses of light that can be used to measure the rapid processes in which electrons move or change energy.
- Their experiments granted the Nobel Laureates to observe extremely brief events that transpire in a few tenths of attoseconds - quintillionth (10^{-18}) of a second.

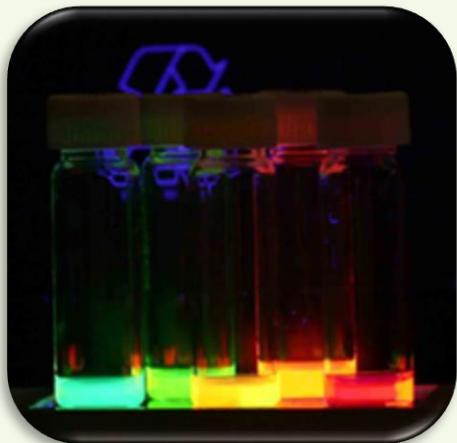
NOBEL CHEMISTRY PRIZE FOR THE DISCOVERY OF QUANTUM DOTS



- The 2023 Nobel Prize in Chemistry has been awarded to Moungi G. Bawendi, Louis E. Brus and Alexei I. Ekimov for the discovery and synthesis of quantum dots.
- Quantum dots have unique properties and now spread their light from television screens and LED lamps. They catalyze chemical reactions, and they illuminate tumor tissue for a surgeon.
- Researchers have primarily utilized quantum dots to create colored light. They believe that in the future, quantum dots can contribute to flexible electronics, minuscule sensors, slimmer solar cells, and perhaps encrypted quantum communication.

Today, quantum dots are an important part of nano technologies toolbox. The prize money is 11 million Swedish kronor to be shared equally between these three laureates.

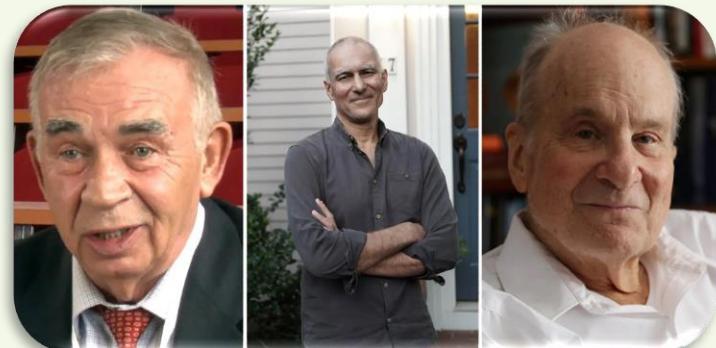
WHAT DO YOU UNDERSTAND BY QUANTUM DOTS?



- Quantum dots are particles that are a few nanometres wide. They exhibit unique optical properties due to their small physical size.
- Their structure and atomic composition are the same as bulk materials, but the properties of the latter don't depend on their size. The properties of quantum dots can be changed by changing their size.
- For the bulk materials, gravity and rules of classical physics dominate but for the particles at the scale of nanometres, quantum physical forces start to dominate and hence, they are capable of new size dependent properties.

MODERN DAY APPLICATIONS OF QUANTUM DOTS

- One of the simplest applications of quantum dots is to light computer monitors and television screens. Blue LEDs behind the screen excite these dots, causing them to emit light of different colours. Combining these colours gives rise to even more colours as well as brightness.
 - These are also used to map biological tissues by biochemists.
 - Quantum dots are also used in photovoltaic cells to improve the absorption and efficiency of solar panels.
 - Certain cancer treatments use quantum dots for targeted drug delivery.
 - They can also be used as security markers on currency and documents as an anti-counterfeit measure.
- Broadly, they can be used as fluorescent markers to tag and track objects.*



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