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NOBEL PHYSICS FOR QUANTUM ENTANGLEMENT & CHEMISTRY PRIZE FOR CLICK CHEMISTRY

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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

- "Nobel Prize in Physics announced: The winners' work, its significance" – Indian Express – 5th October, 2022
- "Nobel Prize 2022: Making chemistry click" – The Indian Express – 6th October, 2022

PROBABLE QUESTION

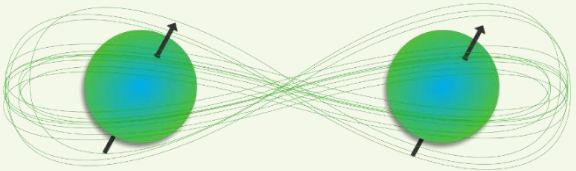
What is the significance of Nobel Physics and Chemistry Prizes, 2022 for the betterment of the humans?

KEY WORDS

- ***Nobel Prize***
- ***Quantum Entanglement***
- ***Photons***
- ***Quantum Mechanics***
- ***Bell Inequalities***
- ***Microscopic World***
- ***Macroscopic World***

NOBEL PRIZE IN PHYSICS, 2022 FOR QUANTUM ENTANGLEMENT

- The Nobel Prize for Physics 2022 is shared by three scientists, Alain Aspect, John Clauser and Anton Zeilinger, for their work on quantum mechanics.
- It was announced by Royal Swedish Academy of Sciences.
- The three scientists won the award "for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science".

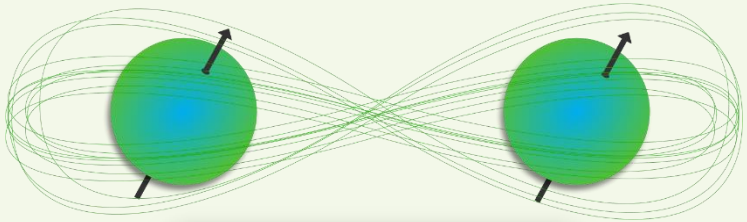


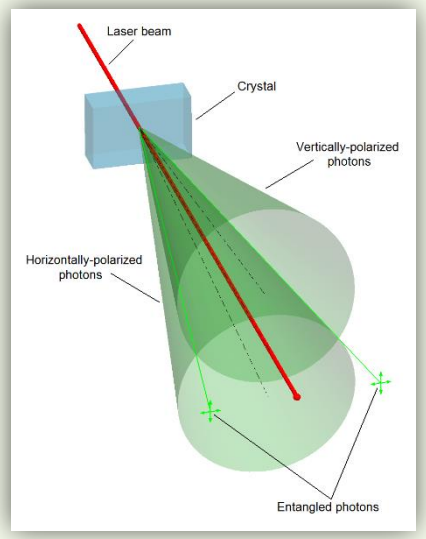
WHAT DO YOU UNDERSTAND BY QUANTUM PHYSICS?

- It is a field of science, to study matter and energy at the most fundamental level.
- Quantum experiments deal with very small objects, such as electrons and photons, and could close gaps in our knowledge of physics to give us a more complete picture of our everyday lives.
- Work around quantum physics began as early as 1800s with observations around atoms as physicists sat down to understand how they work at a fundamental level.

- ISRO in February this year demonstrated satellite based quantum entanglement using real time quantum key distribution.

WHAT IS THE SIGNIFICANCE OF THE EXPERIMENTS DONE BY NOBEL PHYSICS PRIZE WINNERS?





- The three conducted a series of experiments on something called “entangled quantum states”. Here, two separate particles behave like a single unit. It established the violation of so called “Bell inequalities” and pioneered the field of quantum information science.
- Quantum entanglement is a striking example of the difference between the microscopic world and everyday macroscopic experience.

ALBERT EINSTEIN REJECTED THE THEORY OF QUANTUM ENTANGLEMENT!

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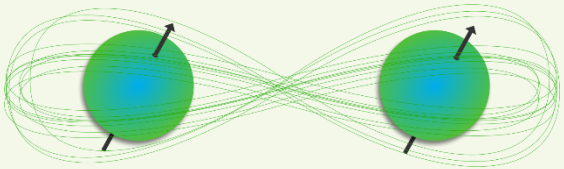
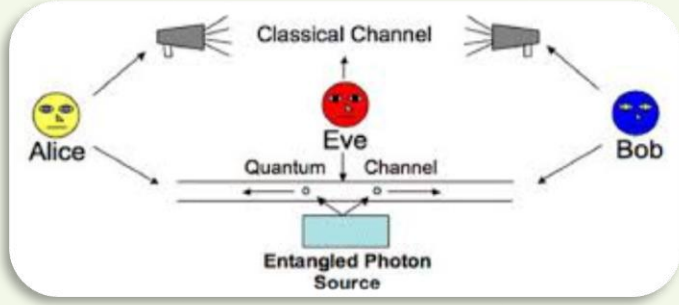
- The quantum entanglement was rejected by Albert Einstein as “spooking action at a distance”.
- In 1964, the late CERN theorist John Bell proposed a theorem known as “Bell inequalities”. It states that, if hidden values are in play, the correlation between the results of a large number of measurements will never exceed a certain value.
- Conversely, if quantum mechanics is complete, this value can be exceeded as measured experimentally.

- As per quantum entanglement, first elucidated by Erwin Schroedinger in 1935, when two particles exist in an entangled state, measurement of one determines the state of the other, no matter how far apart they are.
- These experiments established the basis for a new field of science and technology that has applications in computing, communication, sensing and simulation.

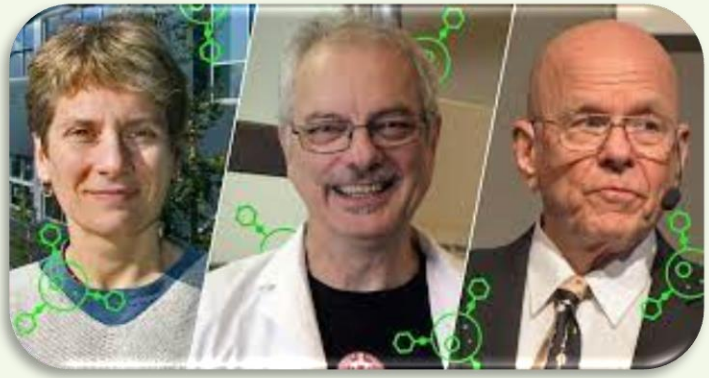


QUANTUM COMMUNICATION IS ONE OF THE SAFEST WAYS OF CONNECTING TWO PLACES!



- Quantum communication is one of the safest ways of connecting two places with high levels of quantum cryptography that cannot be decrypted or broken by an external entity.
- If a cracker tries to crack the message in quantum communication, it changes its form in such a manner that would alert the sender and would cause the message to be altered or deleted.

NOBEL PRIZE IN CHEMISTRY, 2022 IS FOR PRODUCING COMPLEX MOLECULES WITH EASE!



Sharpless, who is the originator of the concept of the click chemistry, has now won the noble prize for the second time, making him only the fifth scientist to achieve this distinction.

- This year's Nobel Prize in Chemistry has gone to three scientists - Carolyn R. Bertozzi (US), Morten Meldal (Denmark) and K Barry Sharpless (US), who through their work adopted an alternative approach in producing new complex molecules in the laboratory, which minimises waste and increases overall efficiency.
- These scientists were awarded with the prize for developing the relatively recent field of "click chemistry" and demonstrating its vast potential in the pharmaceutical and other industries.
- The practical element is to look for the molecules that fit into each other or click with each other and it makes the resulted chemical reaction more efficient.

CLICK CHEMISTRY MEANS - REPLICATING NATURE's EFFICIENCY!

- The idea is adopting a simpler approach to carry out chemical reactions.
- The reacting modules should be in a made for each other kind of situation for a particular reaction, so that the reaction was irreversible and 100% efficiency could be achieved.
- The idea of click chemistry is so appealing that in the pharmaceutical industry, for example, which uses a lot of naturally occurring, but industrially synthesized molecules - every kilogram of a drug produced results in the generation of nearly 95-100 kg of chemical waste.

CLICK CHEMISTRY GIVES GREATEST BENEFIT TO MANKIND ... SAYS THE NOBEL COMMITTEE!

- The Nobel Prize committee said the work of the three scientists, besides being "elegant, clever, novel and useful", also sought to bring the "greatest benefit to humankind".
- The prize deals with not overcomplicating matters, instead working with what is easy and simple.
- Functional molecules can be built even by taking a straightforward route, said the Chair of the Nobel Prize Committee for Chemistry.

Carolyn Bertozzi showed in 2004, that "Click Chemistry" could work in the chemical processes happening in the living cells as well. Her methods have shown the promise of treating advanced cancer.

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