THE GLORY OF BHABHA ATOMIC RESEARCH CENTRE

Atomic Energy Establishment was renamed Bhabha Atomic Research Centre to commemorate Homi Bhabha who died in 1966 in an air crash.

Homi Bhabha was a physicist. Dirac, the Nobel Prize Winner, was Bhabha's friend and teacher. Homi Bhabha was also nominated for Nobel Prize but unfortunately he did not get it. According to his father's wishes he did engineering in England but he told his father thereafter that his line was physics and not engineering.

Maxwell and Boltzmann were the leading physicists in 19th century. Boltzmann created a branch of physics known as statistical physics. Boltzmann (1844–1906) was an Austrian physicist.

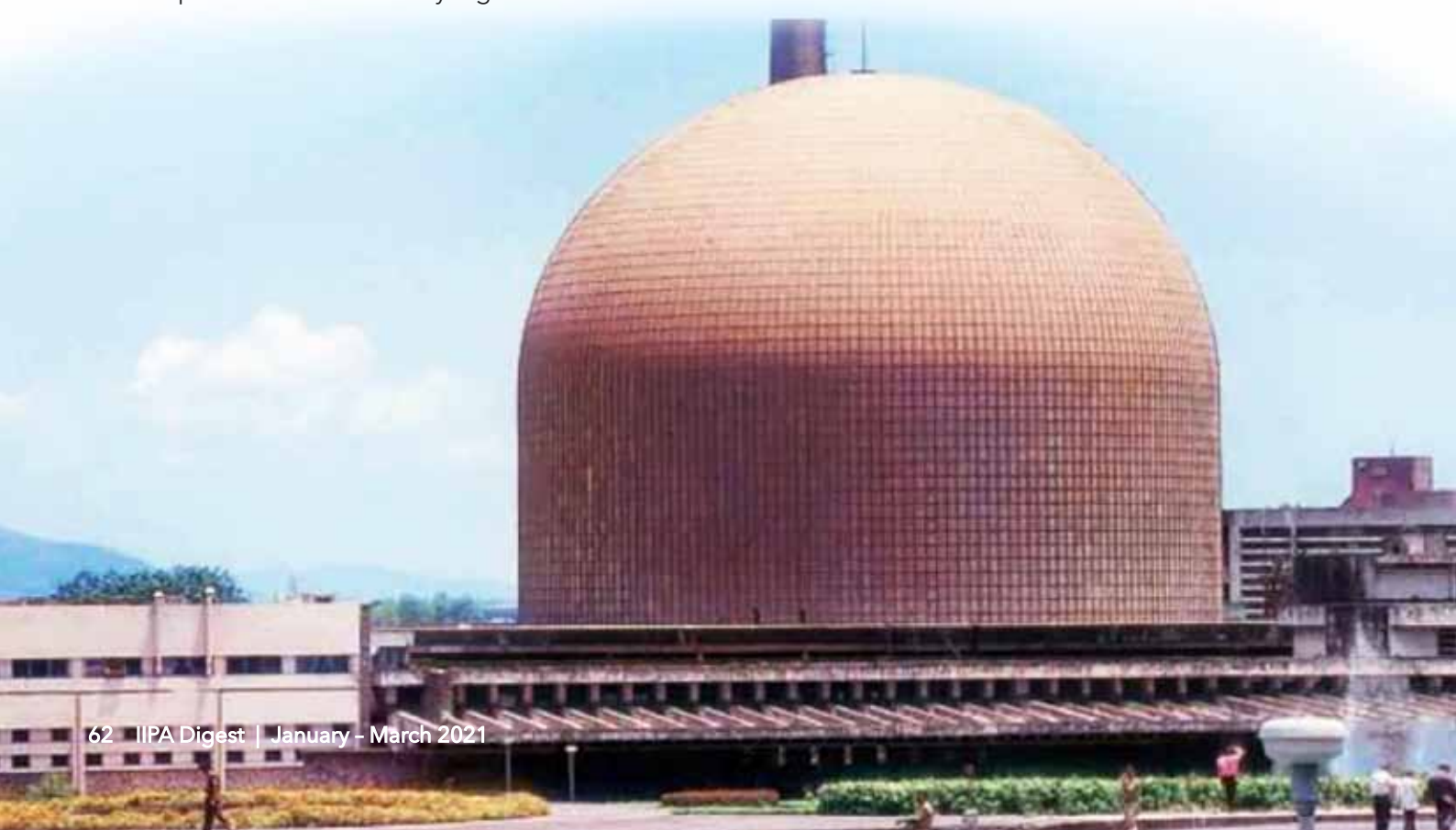
Maxwell (1831 – 1879) was a Scottish physicist. He uncovered the wave-like nature of electric and magnetic fields. The speed of electromagnetic waves predicted by Maxwell coincided with the speed of light. Maxwell concluded that light itself is an electromagnetic wave. Heinrich Hertz confirmed this with experiments. Thus, Maxwell united light, electricity and magnetism. Maxwell's theory of light as a part of electromagnetic spectrum was unscathed by Einstein's theory of relativity.

The statistics of Maxwell and Boltzmann regarded atoms as distinguishable. Quantum Physics changed it. If two photons (electromagnetic waves are also considered as a stream of photons) interchange, the wave function Ψ remains unchanged. This changed the calculation of probability of Maxwell Boltzmann statistics. Bose Einstein statistics was born.

For electrons, the wave function Ψ was also unchanged but it also changed its sign. This can happen only when Ψ was zero. This meant that two electrons with identical quantum numbers cannot exist in the same microstate because Ψ was zero. This changed the calculation of probability differently. Fermi – Dirac statistics was born.

Dirac suggested (and scientific community accepted it) that Bose-Einstein statistics should be called Bose Statistics and Fermi Dirac statistics should be called Fermi Statistics. Photons (which obey Bose Statistics) are called Bosons and Electrons (which obey Fermi statistics) are called Fermions.

Bose statistics and Fermi statistics reduce to Maxwell Boltzmann statistics if density becomes very low or if the temperature becomes very high.



That two electrons having their quantum numbers identical cannot exist in the same microstate is a principle known as Pauli's Exclusion Principle. It was recognized by Pauli. Pauli was awarded Nobel Prize for the Exclusion Principle.

This principle applies to electrons but not to photons because the sign of Ψ does not change for photons but it does for electrons. The probability calculation is different for photons and electrons. Thus, photons (which are Bosons), obey Bose statistics and electrons obey (which are Fermions) Fermi statistics. To exist in the same microstate electron must have their spin different. The spin has only two possibilities.

Spin can be up ↑

or, spin can be down ↓

Two electrons can be there in a microstate only if one electron has its spin up and the other has its spin down.

Dirac was a friend and teacher of Homi Bhabha. Jawaharlal Nehru, the first Prime Minister of India also knew Homi Bhabha. Nehru and Bhabha were good friends. Nehru wanted Bhabha (My dear Homi!) to lead the Atomic Energy programme of India. Bhabha's first love was fundamental physics. He accepted Nehru's request but with conditions. He accepted the offer of Nehru to be the director of the atomic energy program. But he insisted that he should also be appointed secretary of the department of atomic energy (It meant that he did not want an IAS officer above him.)

He also wanted that he should be allowed freedom to ignore Central Public Works Department (CPWD) and Union Public Service Commission (UPSC). He also wanted that the Department of Atomic Energy should be out of Council of Scientific and Industrial Research (CSIR). He also wanted a Ministry of Atomic Energy of which the Department of Atomic Energy should be a part and Jawaharlal Nehru, the Prime Minister, must be the Minister for Atomic Energy. Nehru accepted these conditions.

Bhabha proved to be not only a distinguished scientist but a very able administrator. He was the architect of India's atomic Energy Programme and he continued to be the Director of Tata Institute of Fundamental Research for Fundamental Physics was his first love.

One important policy of Bhabha was not to create a post and then find the person. He spotted the person first and then created a post for him or her.

Bhabha died in an air crash in 1966 and Department of Atomic Energy (and the Ministry of Atomic Energy) are today rightly called Bhabha Atomic Research Centre. The Prime Minister of India continues to be the Cabinet Minister for Atomic Energy. Secretary, Department of Atomic Energy continues to be a Scientist but a non-IAS. ■

AUTHOR

Vasant Kelkar

(The author belongs to the Indian Postal Service batch of 1966. He retired in 2001.)