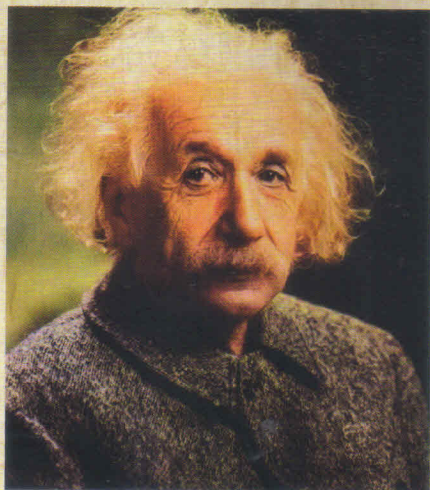


The Centennial of a Quantum Leap

The Impact of Bose's Letter to Einstein

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Albert Einstein



Satyendra Nath Bose

THE 4th of June 1924 marks a pivotal moment in the history of physics — a moment when a young Bengali professor, Satyendra Nath Bose, penned a letter to Albert Einstein that would eventually revolutionise the understanding of quantum mechanics and statistical physics. Despite his initial scepticism regarding whether Einstein would even read his letter, fate intervened favourably. Einstein not only read and translated Bose's work but also recognised its profound implications, leading to its publication in renowned physics journals. This correspondence laid the groundwork for Bose statistics and paved the way for ground-breaking discoveries in the field of quantum mechanics. As this year is the centenary of this monumental event, it is imperative to explore how Bose's contributions have reshaped the world of physics, leading to the discovery of Bosons, the development of Bose-Einstein condensation, and advancements in superconductivity and superfluidity.

The Genesis of Bose Statistics

Satyendra Nath Bose's journey into the annals of scientific history began with his attempts to teach Planck's theory of black-body radiation to his students at Dacca University, now in Bangladesh. Planck's law, which describes the distribution of electromagnetic radiation emitted by a black body in thermal equilibrium, had a crucial limitation. While it successfully explained experimental results, it did not align with classical

statistical mechanics. Bose identified a fundamental flaw in the way particles were counted and distributed in Planck's theory. He proposed a new approach, which later became known as Bose statistics.

Bose's theory diverged from classical statistics by treating photons (particles of light) not as distinguishable entities but as indistinguishable ones. This shift in perspective led to a novel distribution law that accurately described the behaviour of photons, providing a more robust theoretical foundation for Planck's radiation law. Bose's insights were revolutionary, but his paper was initially rejected by journals in London. Undeterred, Bose sent his manuscript directly to Einstein, hoping that the luminary physicist might find merit in his ideas.

Einstein's Endorsement and the Birth of New Statistics

Albert Einstein's response to Bose's letter was nothing short of transformative. Recognising the significance of Bose's work, Einstein translated the paper into German and submitted it to the journal "*Zeitschrift für Physik*," where it was published in 1924. Einstein did not stop there; he extended Bose's ideas to atoms, predicting a new state of matter — now known as Bose-Einstein Condensate (BEC).

The publication of Bose's work and Einstein's endorsement effectively established Bose statistics as a cornerstone of quantum mechanics. Bose statistics describe the distribution