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PETER HIGGS AND HIS BOSON – THE PARTICLE OF GOD

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"I never expected this to happen in my lifetime and shall be asking my family to put some champagne in the fridge."
Peter Higgs

Annotation. *This article delves into the life and scientific contributions of Peter Higgs, a renowned British physicist whose work revolutionized our understanding of particle physics. From his early struggles with health and education to his groundbreaking theoretical predictions and eventual Nobel Prize-winning discovery of the Higgs boson, Higgs's journey is a testament to the power of perseverance and intellectual curiosity. Through a structured exploration of Higgs's biography, scientific achievements, and impact on modern physics, the article sheds light on the intricate complexities of particle physics and the profound implications of Higgs's work.*

Keywords: *Peter Higgs, physicist, particle physics, Higgs boson, Nobel Prize, scientific discovery, theoretical physics, particle accelerator, Standard Model, elementary particles.*

Introduction.

In the realm of science, there exist names that serve as epicenters of revolutionary shifts in the comprehension of fundamental laws of nature. One such luminary is Peter Higgs. His name is invariably associated with the elucidation of a pivotal component of the Standard Model of particle physics - the boson, now bearing his namesake. The life and scientific endeavors of Higgs epitomize steadfast inquiry, creative thought, and profound influence on the discipline of physics.

Research objectives:

1. Investigate the formative experiences and key milestones in Peter Higgs's scientific career.
2. Analyze Peter Higgs's seminal discoveries in the field of particle physics, with a focus on his theoretical framework for the existence of the Higgs boson and its implications for our understanding of fundamental particles and forces in the universe.
3. Examine the contemporary significance of the Higgs boson in modern science.
4. Evaluate the significance and impact of Peter Higgs's contributions to science through the lens of the Nobel Prize in Physics.

Background. Peter Higgs was born in the Elswick area of Newcastle upon Tyne, England, in 1929. His father, Thomas Ware Higgs, worked as a sound engineer at the BBC. Due to asthma, he frequently missed school and received education at home. His academic pursuits were influenced by his father's job-related relocations and the upheaval of World War II.

In 1946, at the age of 17, Higgs enrolled at the City of London School, specializing in mathematics. Subsequently, in 1947, he matriculated at the Royal College of London, where he obtained a Bachelor's degree in physics in 1950 and a Doctor of Philosophy degree in 1954 [2].

Following the defense of his dissertation, Higgs served as a senior researcher at the University of Edinburgh (1954 – 1956), after which he held various positions at Imperial College London and University College London. In 1960, he returned to the University of Edinburgh, assuming a faculty position at the Tait Institute of Mathematical Physics.

In 1964, Higgs published his seminal paper, in which he postulated the existence of the Higgs boson, which became a cornerstone of the Standard Model of elementary particles.

Peter Higgs's Scientific Career And Discoveries.

In 1954, Higgs defended his dissertation titled "Some Problems in the Theory of Molecular Vibrations." That same year, he commenced his teaching tenure at the University of Edinburgh. Peter's formative years were significantly influenced by the summer schools hosted by this institution in the 1960s, featuring luminaries such as Sheldon Glashow and Martinus Veltman, later Nobel laureates [4].

During his youth, Higgs was considered eccentric for pursuing ideas that other physicists viewed skeptically. At that time, there were contentious debates in science regarding how particles acquire mass. Recognizing the shortcomings of prevailing theories, in 1964, he authored an extensive paper outlining his own perspective on the matter.

British scientific journals rejected Higgs's publication, prompting him to add two paragraphs and publish it in an American scientific journal. In the penultimate sentence, Peter first mentioned the existence of a new particle, subsequently dubbed the "Higgs boson." The scientific community greeted the British physicist's theory with skepticism, with Stephen Hawking even stating that the Higgs boson would never be found.

Higgs's groundbreaking discovery elucidated how elementary particles obtain mass: through interaction with an invisible "Higgs field" permeating space. However, the existence of the new particle still needed to be proven. Over the course of three decades, Peter Higgs, along with Belgian François Englert and his co-author Robert Brout, conducted experiments, attempting to reproduce the Big Bang by colliding particles, in hopes of observing the Higgs boson in resultant mini-explosions.

In 2012, with the aid of the Large Hadron Collider, the existence of the particle was confirmed. On July 4th, as Higgs entered the lecture hall of the European Organization for Nuclear Research, he was greeted with thunderous applause. Viewers from around the globe watched live as the professor shed tears of overwhelming emotion [5].

Fig. 1. Peter Higgs and Stephen Hawking

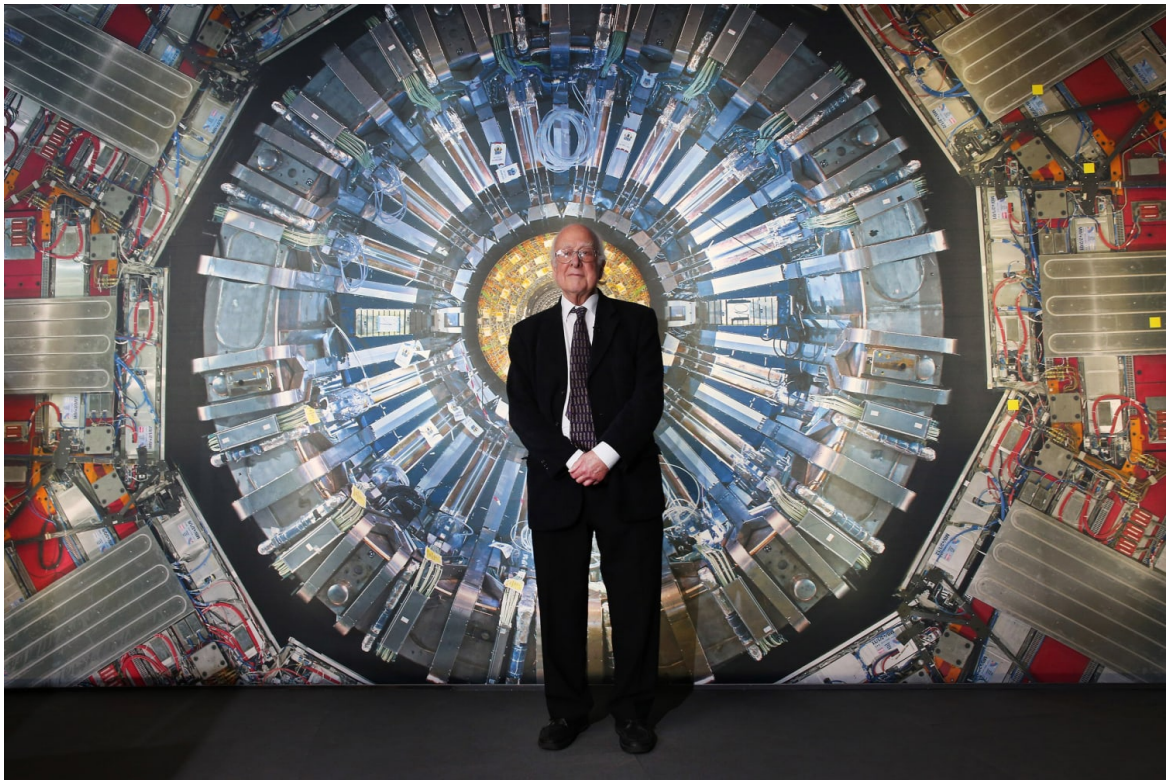

Fig. 2. Peter Higgs at the discovery of the Higgs boson in front of the Hadron Collider.

The role of the higgs boson in modern science. At the time, scientists were not precisely certain how closely the particle they had discovered corresponded to the predictions of the Standard Model. By March 2013, physicists had amassed sufficient data on the particle to officially declare it as the Higgs boson. A boson is a type of

subatomic particle. Each energy field possesses a specific particle that dictates its interaction with the surrounding environment. According to scientific data, the mass of the Higgs boson is approximately 125.36 ± 0.41 gigaelectronvolts [1].

The Higgs boson serves as the missing link that aids physicists in understanding the structure of the universe. It was postulated by physicists that space is permeated by Higgs bosons. Upon interacting with other elementary particles, bosons impart their mass to them. Therefore, if the mass of certain elementary particles can be calculated, then the mass of the Higgs boson can also be determined. Conversely, knowing the mass of the Higgs boson allows for the calculation of the masses of other elementary particles [3].

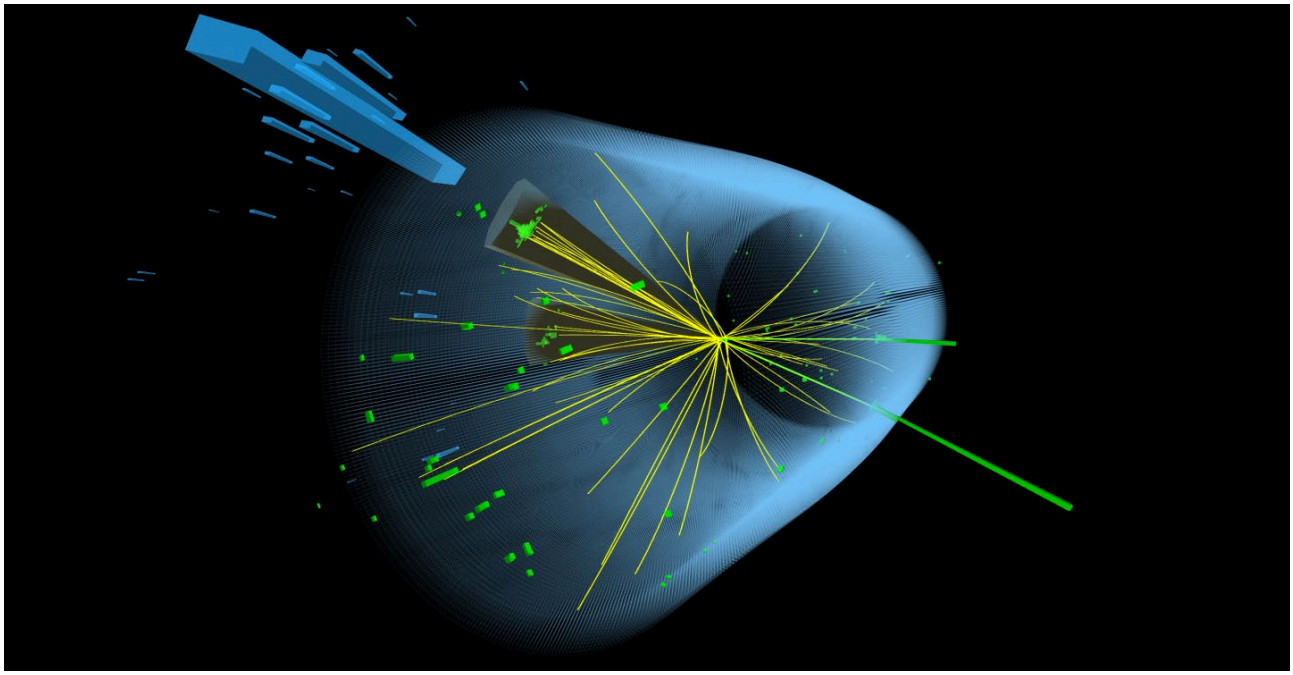

Fig. 3. The Higgs boson

The discovery of the Higgs boson provides robust support for the Standard Model, offering physical evidence of the universe's invisible field that endowed mass to all matter after the Big Bang, compelling particles to coalesce into stars, planets, and all else. Were the boson not found, the entire theoretical physics framework would collapse. "No Higgs boson—no mass, no mass—no you, no me, no anything else."

The discovery of the Higgs boson has engendered new concerns in science. For instance, Stephen Hawking, in his book "The Grand Design," suggested that the Higgs boson might become unstable at energies exceeding 100 billion gigaelectronvolts (GeV) and, under certain circumstances, could lead to vacuum decay and the complete disappearance of concepts such as space and time. However, he also reassures, stating that such a catastrophe is unlikely, as a particle accelerator reaching 100 billion GeV would need to be larger than the Earth, and it is unlikely to be funded given the current economic conditions [3].

Modern science is not static but continuously and steadily evolves. As of now, there are no practical applications for the Higgs boson. Therefore, contemporary

physicists and astronomers still have much work and experimentation ahead concerning the study of this universe's foundational particle. Scientists anticipate that in several decades, thanks to the discovery of the Higgs boson, it will be possible to...

The Nobel Prize.

The Nobel Prize in Physics for the year 2013 was awarded to British scientist Peter Higgs and Belgian physicist François Englert for the theoretical underpinning of the existence of the boson – a particle through which other elementary particles acquire mass [2]. In the 1960s, they were part of a group of physicists striving to explain the physical phenomenon of mass in elementary particles.

Their proposed theory predicted the existence of a particle, subsequently named the Higgs boson, which was detected at the Large Hadron Collider at CERN in 2012. In developing the theory, alongside Higgs and Englert, were Carl Hagen, Tom Kibble, and Gerald Guralnik, as well as Robert Brout, who passed away in 2011.

Professor Ruben Saakyan of University College London is confident that experimental physicists in Switzerland indeed confirmed the existence of the very particle predicted by Higgs and other theorists.

"This year's prize is dedicated to something very small that explains everything else in our world," said Staffan Normark, Permanent Secretary of the Royal Swedish Academy of Sciences.

Fig. 4. Peter Higgs at the Nobel Prize award ceremony

Conclusions.

In conclusion, the life and work of Peter Higgs exemplify the relentless pursuit of scientific understanding and the profound impact a single individual can have on our collective knowledge of the universe. From his early years marked by academic resilience to his groundbreaking theoretical contributions, Higgs's journey embodies the essence of scientific inquiry and innovation.

The discovery of the Higgs boson, culminating in the Nobel Prize in Physics in 2013, stands as a testament to Higgs's visionary insights and the collaborative efforts of the scientific community. His theoretical groundwork, alongside that of his

contemporaries, has not only provided a crucial piece to the puzzle of particle physics but has also deepened our comprehension of the fundamental forces shaping the cosmos.

Moreover, Higgs's humility and dedication serve as an inspiration to aspiring scientists worldwide, emphasizing the importance of curiosity, perseverance, and interdisciplinary collaboration in pushing the boundaries of human knowledge.

As we reflect on Peter Higgs's remarkable contributions, we are reminded of the transformative power of scientific exploration and the enduring legacy of those who dare to question, imagine, and explore the mysteries of the universe.

References:

1. Jakobs K., Zanderighi G. The profile of the Higgs boson: status and prospects. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*. 2023. Vol. 382, no. 2266. URL: https://doi.org/10.1098/rsta.2023.0087

2. My Life as a Boson: The Story of “The Higgs". *People*. 2012. 6 September. P. 50–51. URL: https://nucleares.unam.mx/~bijker/subnuclear/HiggsBoson.pdf.

3. Raychaudhuri S. The Higgs Boson and its physics: an overview. *Indian Journal of Physics*. 2023. URL: https://doi.org/10.1007/s12648-023-02718-8

4. Rodgers P. Peter Higgs: the man behind the boson. *Physics World*. 2004. Vol. 17, no. 7. P. 10–11. URL: https://doi.org/10.1088/2058-7058/17/7/17

5. Sutton C. Peter Higgs obituary: physicist who predicted boson that explains why particles have mass. *Nature*. 2024. URL: https://doi.org/10.1038/d41586-024-01103-7

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