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Peter Higgs

Peter Ware Higgs CH FRS FRSE FInstP (born 29 May 1929) is a British theoretical physicist, emeritus professor in the University of Edinburgh,^{[5][6]} and Nobel Prize laureate for his work on the mass of subatomic particles.^[7]

In the 1960s, he proposed that broken symmetry in electroweak theory could explain the origin of mass of elementary particles in general and of the W and Z bosons in particular. This so-called Higgs mechanism, which was proposed by several physicists besides Higgs at about the same time, predicts the existence of a new particle, the Higgs boson, the detection of which became one of the great goals of physics.^{[8][9]} On 4 July 2012, CERN announced the discovery of the boson at the Large Hadron Collider.^[10] The Higgs mechanism is generally accepted as an important ingredient in the Standard Model of particle physics, without which certain particles would have no mass.^[11]

Higgs has been honoured with a number of awards in recognition of his work, including the 1981 Hughes Medal from the Royal Society; the 1984 Rutherford Medal from the Institute of Physics; the 1997 Dirac Medal and Prize for outstanding contributions to theoretical physics from the Institute of Physics; the 1997 High Energy and Particle Physics Prize by the European Physical Society; the 2004 Wolf Prize in Physics; the 2009 Oskar Klein Memorial Lecture medal from the Royal Swedish Academy of Sciences; the 2010 American Physical Society J. J. Sakurai Prize for Theoretical Particle Physics; and a unique Higgs Medal from the Royal Society of Edinburgh in 2012.^[12] The discovery of the Higgs boson prompted fellow physicist Stephen Hawking to note that he thought that Higgs should receive the Nobel Prize in Physics for his work,^{[13][14]} which he finally did, shared with François Englert in 2013.^[15] Higgs was appointed to the Order of the Companions of Honour in the 2013 New Year Honours^{[16][17]} and in 2015 the Royal Society awarded him the Copley Medal, the world's oldest scientific prize.^[18]

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Peter Higgs

CH FRS FRSE FInstP



Nobel laureate Peter Higgs at a press conference, Stockholm, December 2013

Born	Peter Ware Higgs 29 May 1929 Newcastle upon Tyne, England
Residence	Edinburgh, Scotland
Nationality	British ^[1]
Alma mater	King's College London (BSc, MSc, PhD)
Known for	Higgs boson Higgs field Higgs mechanism Symmetry breaking
Awards	Nobel Prize in Physics (2013) Wolf Prize in Physics (2004) Sakurai Prize (2010) Dirac Medal (1997) Rutherford Medal (1984)

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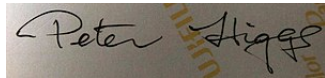
Early life and education

Higgs was born in the Elswick district of Newcastle upon Tyne, England, to Thomas Ware Higgs (1898-1962) and his wife Gertrude Maude née Coghill (1895-1969).^{[12][19][20][21][22]} His father worked as a sound engineer for the BBC, and as a result of childhood asthma, together with the family moving around because of his father's job and later World War II, Higgs missed some early schooling and was taught at home. When his father relocated to Bedford, Higgs stayed behind with his mother in Bristol, and was largely raised there. He attended Cotham Grammar School in Bristol from 1941–46,^{[12][23]} where he was inspired by the work of one of the school's alumni, Paul Dirac, a founder of the field of quantum mechanics.^[21]

In 1946, at the age of 17, Higgs moved to City of London School, where he specialised in mathematics, then in 1947 to King's College London where he graduated with a first class honours degree in Physics in 1950 and achieved a master's degree in 1952. He was awarded an 1851 Research Fellowship from the Royal Commission for the Exhibition of 1851,^[24] and performed his doctoral research in molecular physics under the supervision of Charles Coulson and Christopher Longuet-Higgins.^[2] He was awarded a PhD degree in 1954 with a thesis entitled *Some problems in the theory of molecular vibrations*.^{[2][12][25]}

Career and research

After finishing his doctorate, Higgs was appointed a Senior Research Fellow at the University of Edinburgh (1954–56). He then held various posts at Imperial College London, and University College London (where he also became a temporary lecturer in Mathematics). He returned to the University of Edinburgh in 1960 to take up the post of Lecturer at the Tait Institute of Mathematical Physics, allowing him to settle in the city he had enjoyed while hitchhiking to the Western Highlands as a student in 1949.^{[26][27]} He was promoted to Reader, became a Fellow of the Fellow of the Royal Society of Edinburgh (FRSE) in 1974 and was promoted to a Personal Chair of Theoretical Physics in 1980. He retired in 1996 and became Emeritus professor at the University of Edinburgh.^[5]

	FRS (1983) Hughes Medal (1981) Copley Medal (2015)
	Scientific career
Fields	Theoretical physics
Institutions	University of Edinburgh Imperial College London University College London King's College London
Thesis	<i>Some problems in the theory of molecular vibrations</i> (http://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.572829) (1955)
Doctoral advisor	Charles Coulson ^{[2][3]} Christopher Longuet-Higgins ^{[2][4]}
Doctoral students	Lewis Ryder David Wallace ^[3]
Website	www.ph.ed.ac.uk/higgs (http://www.ph.ed.ac.uk/higgs)
	Signature
	

Higgs was elected Fellow of the Royal Society (FRS) in 1983 and Fellow of the Institute of Physics (FInstP) in 1991. He was awarded the Rutherford Medal and Prize in 1984. He received an honorary degree from the University of Bristol in 1997. In 2008 he received an Honorary Fellowship from Swansea University for his work in particle physics.^[28]

At Edinburgh Higgs first became interested in mass, developing the idea that particles – massless when the universe began – acquired mass a fraction of a second later as a result of interacting with a theoretical field (which became known as the Higgs field). Higgs postulated that this field permeates space, giving mass to all elementary subatomic particles that interact with it.^{[21][29]}

The Higgs mechanism postulates the existence of the Higgs field which confers mass on quarks and leptons.^[30] However this causes only a tiny portion of the masses of other subatomic particles, such as protons and neutrons. In these, gluons that bind quarks together confer most of the particle mass.

The original basis of Higgs' work came from the Japanese-born theorist and Nobel Prize laureate Yoichiro Nambu from the University of Chicago. Professor Nambu had proposed a theory known as spontaneous symmetry breaking based on what was known to happen in superconductivity in condensed matter; however, the theory predicted massless particles (the Goldstone's theorem), a clearly incorrect prediction.^[5]

Higgs is reported to have developed the basic fundamentals of his theory after returning to his Edinburgh New Town apartment from a failed weekend camping trip to the Highlands.^{[31][32][33]} He stated that there was no "eureka moment" in the development of the theory.^[34] He wrote a short paper exploiting a loophole in Goldstone's theorem (massless Goldstone particles need not occur when local symmetry is spontaneously broken in a relativistic theory^[35]) and published it in Physics Letters, a European physics journal edited at CERN, in Switzerland, in 1964.^[36]

Higgs wrote a second paper describing a theoretical model (now called the Higgs mechanism), but the paper was rejected (the editors of Physics Letters judged it "of no obvious relevance to physics"^[21]). Higgs wrote an extra paragraph and sent his paper to Physical Review Letters, another leading physics journal, which published it later in 1964. This paper predicted a new massive spin-zero boson (now known as the Higgs Boson).^{[35][37]} Other physicists, Robert Brout and Francois Englert^[38] and Gerald Guralnik, C. R. Hagen and Tom Kibble^[39] had reached similar conclusions about the same time. In the published version Higgs quotes Brout and Englert and the third paper quotes the previous ones. The three papers written on this boson discovery by Higgs, Guralnik, Hagen, Kibble, Brout, and Englert were each recognized as milestone papers by Physical Review Letters 50th anniversary celebration.^[40] While each of these famous papers took similar approaches, the contributions and differences between the 1964 PRL symmetry breaking papers are noteworthy. The mechanism had been proposed in 1962 by Philip Anderson although he did not include a crucial relativistic model.^{[35][41]}

On 4 July 2012, CERN announced the ATLAS and Compact Muon Solenoid (CMS) experiments had seen strong indications for the presence of a new particle, which could be the Higgs boson, in the mass region around 126 gigaelectronvolts (GeV).^[42] Speaking at the seminar in Geneva, Higgs commented "It's really an incredible thing that it's happened in my lifetime."^[10] Ironically, this probable confirmation of the Higgs Boson was made at the same place where the editor of Physics Letters rejected Higgs' paper.^[5]

Awards and honours

Higgs has received numerous accolades including:

Civic Awards

Higgs was the recipient of the Edinburgh Award for 2011. He is the fifth person to receive the Award, which was established in 2007 by the City of Edinburgh Council to honour an outstanding individual who has made a positive impact on the city and gained national and international recognition for Edinburgh.^[43]

Higgs was presented with an engraved loving cup by the Rt Hon George Grubb, Lord Provost of Edinburgh, in a ceremony held at the City Chambers on Friday 24 February 2012. The event also marked the unveiling of his handprints in the City Chambers quadrangle, where they had been engraved in Caithness stone alongside those of previous Edinburgh Award recipients.^{[44][45][46]}

Prof Higgs was awarded with the Freedom of the City of Bristol in July 2013. In April 2014, he was also awarded the Freedom of the City of Newcastle upon Tyne. He was also honoured with a brass plaque installed on the Newcastle Quayside as part of the Newcastle Gateshead Initiative Local Heroes Walk of Fame.

Higgs Centre for Theoretical Physics

On 6 July 2012, Edinburgh University announced a new centre named after Professor Higgs to support future research in theoretical physics. The Higgs Centre for Theoretical Physics brings together scientists from around the world to seek "a deeper understanding of how the universe works".^[47] The centre is currently based within the James Clerk Maxwell Building, home of the University's School of Physics and Astronomy and the iGEM 2015 team (ClassAfiED). The university has also established a chair of theoretical physics in the name of Peter Higgs.^{[48][49]}

Nobel Prize in Physics

On 8 October 2013, it was announced that Peter Higgs and François Englert would share the 2013 Nobel Prize in Physics "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles", and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider".^[50] Higgs admits he had gone out to avoid the media attention^[51] so he was informed he had been awarded the prize by an ex-neighbour on his way home, since he did not have a mobile phone.^{[52][53]}

Companion of Honour

Higgs turned down a knighthood in 1999, but in 2012 he accepted membership of The Order of the Companion of Honour.^{[54][55]} A Guardian interview with the physicist later stated that he only accepted the order because he was wrongly assured that the award was the gift of the Queen alone. He also expressed cynicism towards the honours system, and the way the system "is used for political purposes by the government in power". The order confers no title or precedence, but recipients of the order are entitled to use the post-nominal letters CH. In the same interview he also stated that when people ask what the CH after his name stands for, he replies "it means I'm an honorary Swiss."^[56] He received the order from the Queen at an investiture at Holyrood House on 1 July 2014.^[57]

Honorary Degrees

Higgs has been awarded honorary degrees from the following institutions:

- DSc [University of Bristol](#) 1997^[58]
- DSc [University of Edinburgh](#) 1998^[58]
- DSc [University of Glasgow](#) 2002^[58]
- DSc [Swansea University](#) 2008^[58]
- DSc [King's College London](#) 2009^[58]
- DSc [University College London](#) 2010^[58]
- DSc [University of Cambridge](#) 2012^[58]
- DSc [Heriot-Watt University](#) 2012^[58]
- PhD [SISSA, Trieste](#) 2013^[58]
- DSc [University of Durham](#) 2013^[58]
- DSc [University of Manchester](#) 2013^[58]
- DSc [University of St Andrews](#) 2014^[58]
- DSc [Free University of Brussels \(ULB\)](#) 2014^[58]
- DSc [University of North Carolina at Chapel Hill](#) 2015^[58]
- DSc [Queen's University Belfast](#) 2015^[58]



Peter Higgs portrait by Lucinda Mackay hanging at James Clerk Maxwell Foundation

A portrait of Higgs was painted by [Ken Currie](#) in 2008.^[59] Commissioned by the University of Edinburgh,^[60] it was unveiled on 3 April 2009^[61] and hangs in the entrance of the [James Clerk Maxwell Building](#) of the [School of Physics and Astronomy](#) and the [School of Mathematics](#).^[59] A large portrait by Lucinda Mackay is in the collection of the [Scottish National Portrait Gallery](#) in Edinburgh. Another portrait of Higgs by the same artist hangs in the birthplace of James Clerk Maxwell in Edinburgh, Higgs is the Honorary Patron of the [James Clerk Maxwell Foundation](#). A portrait by [Victoria Crowe](#) was commissioned by the Royal Society of Edinburgh and unveiled in 2013.^[62]

Personal life and political views

Higgs married Jody Williamson, a fellow activist with the [Campaign for Nuclear Disarmament \(CND\)](#) in 1963. Their first son was born in August 1965.^[63] Higgs's family includes two sons: Chris, a computer scientist, and Jonny, a jazz musician.^[64] He has two grandchildren. The entire family lives in Edinburgh.^[45]

Higgs was an activist in the CND while in London and later in Edinburgh, but resigned his membership when the group extended its remit from campaigning against nuclear weapons to campaigning against nuclear power too.^{[21][65]} He was a [Greenpeace](#) member until the group opposed [genetically modified organisms](#).^[65]

Higgs was awarded the 2004 [Wolf Prize in Physics](#) (sharing it with Brout and Englert), but he refused to fly to Jerusalem to receive the award because it was a state occasion attended by the then president of Israel, [Moshe Katsav](#), and Higgs is opposed to Israel's actions in Palestine.^[66]

Higgs was actively involved in the Edinburgh University branch of the [Association of University Teachers](#), through which he agitated for greater staff involvement in the management of the physics department.^[56]

Higgs is an atheist.^[67] He has described [Richard Dawkins](#) as having adopted a "fundamentalist" view of non-atheists.^[68] Higgs expressed later that he was displeased that the Higgs particle is nicknamed the "God particle",^[69] as he believes the term "might offend people who are religious".^[64] Usually this nickname for the Higgs boson is attributed to [Leon Lederman](#), the author of the book *The God Particle: If the Universe Is the Answer, What Is the Question?*, but the name is the result of the suggestion of Lederman's publisher: Lederman had originally intended to refer to it as the "goddamn particle".^[70]

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External links

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- [BBC profile of Peter Higgs \(https://www.bbc.co.uk/news/science-environment-16222710\)](https://www.bbc.co.uk/news/science-environment-16222710)
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- [Physical Review Letters – 50th Anniversary Milestone Papers \(http://prl.aps.org/50years/milestones#1964\)](http://prl.aps.org/50years/milestones#1964)
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- [Sakurai Prize Videos \(https://www.youtube.com/view_play_list?p=BDA16F52CA3C9B1D\)](https://www.youtube.com/view_play_list?p=BDA16F52CA3C9B1D)
- [«I wish they hadn't dubbed it "The God Particle"» Interview with Peter Higgs \(http://metode.cat/en/Issues/Interview/Peter-Higgs\)](http://metode.cat/en/Issues/Interview/Peter-Higgs)
- [Peter Higgs: I wouldn't be productive enough for today's academic system \(https://www.theguardian.com/science/2013/dec/06/peter-higgs-boson-academic-system\)](https://www.theguardian.com/science/2013/dec/06/peter-higgs-boson-academic-system)

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Preceded by <u>Serge Haroche</u> <u>David J. Wineland</u>	<u>Nobel Prize in Physics laureate</u> 2013 With: <u>François Englert</u>	Succeeded by <u>Isamu Akasaki</u> <u>Hiroshi Amano</u> <u>Shuji Nakamura</u>

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