

Press release**Joachim Herz Stiftung****Sarah Bloch**

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<http://idw-online.de/en/news817104>Contests / awards, Personnel announcements
Mathematics, Physics / astronomy
transregional, national**String theorist Edward Witten is awarded the Hamburg Prize for Theoretical Physics**

The American physicist Edward Witten will be awarded the Hamburg Prize for Theoretical Physics 2023. He is being recognized for his groundbreaking contributions to a unified mathematical description of fundamental forces of nature. His outstanding research on string and quantum theory has had a profound impact on our understanding of space, time, matter, and the structure of the cosmos. The Hamburg Prize for Theoretical Physics is awarded by the Joachim Herz Foundation together with the Wolfgang Pauli Centre of DESY and Universität Hamburg, the Deutsches Elektronen-Synchrotron DESY and the Clusters of Excellence "CUI: Advanced Imaging of Matter" and "Quantum Universe" at Universität Hamburg

Edward Witten ranks among the most renowned and frequently cited theoretical physicists of our time. He has been providing important momentum for the development of a grand unified theory of physics that describes all the forces and building blocks of the universe for decades. String theory has been seen as a promising candidate for this since the 1970s since it builds a bridge between two established cornerstones of physics: Quantum theory, which governs the interaction of subatomic particles, along with Albert Einstein's general theory of relativity, describing gravity as a consequence of the curvature of space and predicting the evolution of stars, galaxies, and black holes.

Building the bridge between two cornerstones of physics

String theory suggests that quantum and gravitational theory can be unified under the umbrella of a new mathematical formalism. This involves looking at elementary particles as tiny line-shaped objects, the strings. Quarks, electrons, and all other known elementary particles are consequently nothing other than different oscillation patterns of the same particle. It was in the 1980s that it became clear, with the significant participation of Edward Witten, that this paradigm shift would allow all four fundamental forces of nature – gravitation, electromagnetism, weak interaction, strong nuclear force – to be described by a unified quantum mechanical field theory.

A puzzle remained that there were five possible versions of string theory known at that time. If one of those theories describes our universe, who lives in the other four worlds? Drawing upon clues that had emerged in the work of many colleagues, Witten presented a resolution to this question at a conference in California in 1995: All five variants of string theory are different limiting cases of one underlying theory. They look different when quantum effects are weak, but when quantum mechanical effects are fully taken into account, the differences between the string theories melt away. The five string theories are all manifestations of a single underlying "M-theory", which is the candidate for superunification of the laws of nature.

"This year, we are honoring a scientist in Edward Witten, whose work has been groundbreaking for the development of string theory and quantum field theory and has also generated important momentum well beyond this. We would like to pay homage to this achievement and his work where physics and mathematics converge by awarding him the Hamburg Prize for Theoretical Physics," says Sabine Kunst, Chairwoman of the Executive Board of the Joachim Herz Foundation.

Impetus for cutting-edge research in Hamburg

The Hamburg Prize for Theoretical Physics has been awarded to internationally renowned researchers since 2010 now. It is one of the most valuable science prizes for physics in Germany. The prize money amounts to € 137,036, which is a reference to Sommerfeld's fine-structure constant, which plays an important role in theoretical physics.

The physics prize awarded to Edward Witten also includes a research residency in Hamburg. "Edward Witten's pioneering work is closely linked to the Science City Hamburg Bahrenfeld, for instance, through the research focuses in the Cluster of Excellence "Quantum Universe" and above all also at the Hamburg Center for Mathematical Physics, founded jointly by DESY and Universität Hamburg as of 2004. We are therefore eagerly looking forward to exchanging thoughts with this luminary," says Volker Schomerus, leading scientist at DESY and spokesperson for the Wolfgang Pauli Centre.

Outstanding achievements where physics and mathematics converge

Over the course of his career, Edward Witten has not only made a name for himself as a leading string theorist. He has also generated important momentum in other areas of mathematical physics, from quantum field theory to condensed matter physics, sometimes with applications to gravity and astronomy. His work on topological quantum field theory, for example, paved the way for mathematicians to understand the geometric structures and regularities of knots in the late 1980s. Edward Witten's extraordinary ability to apply abstract concepts, such as Richard Feynman's famous path integrals, from physics to mathematics, places him as a towering figure at the crossroads of the two disciplines. Edward Witten has been the recipient of many awards, including being in 1990 the first physicist to ever receive the Fields Medal, regarded as the highest award for mathematicians.

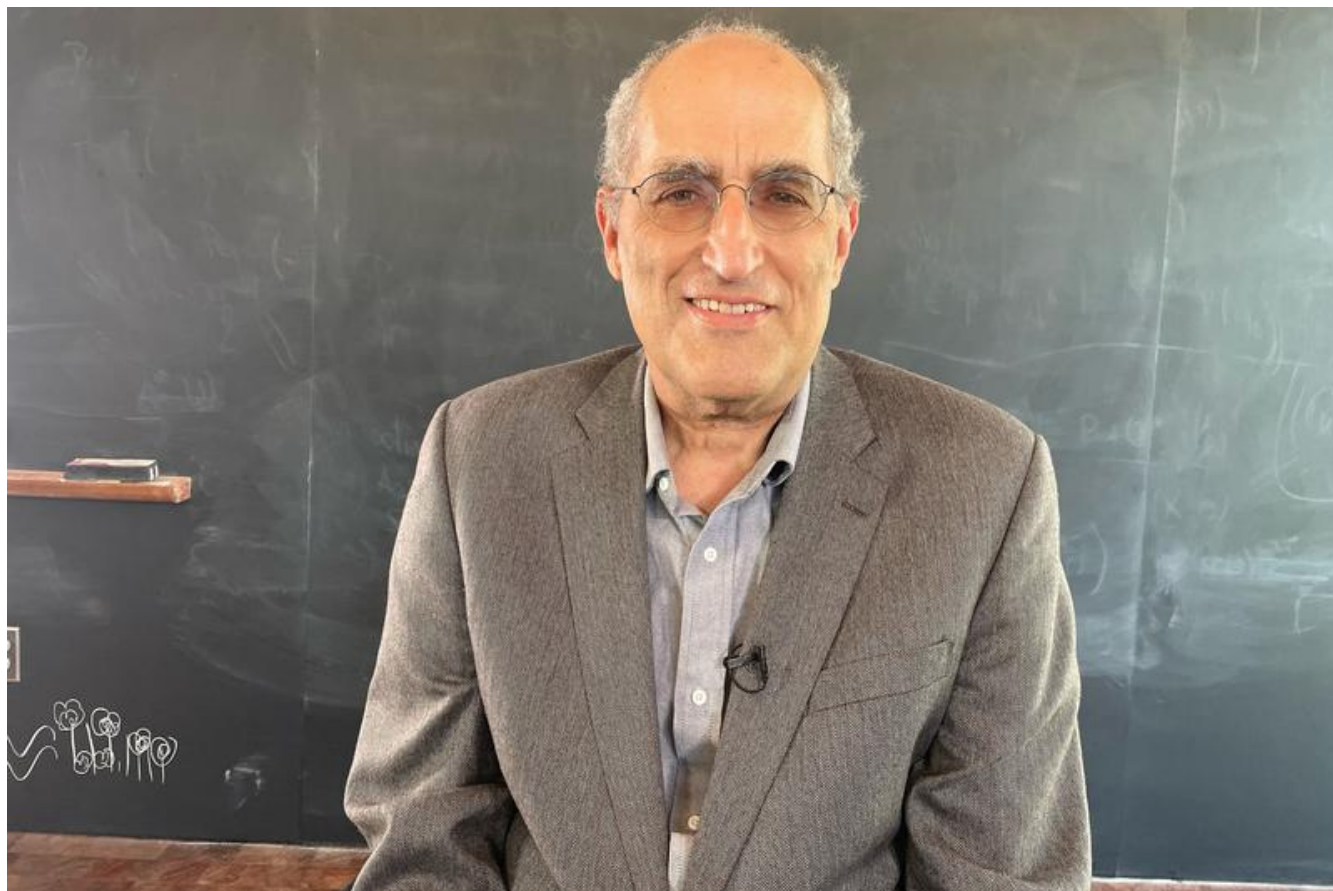
About Edward Witten

Edward Witten was born in Baltimore, Maryland, in 1951. Following a bachelor's degree at Brandeis University in Massachusetts, he studied applied mathematics and physics at Princeton University, New Jersey. The Ph.D. advisor for his work on quantum gauge theories was David Gross, who was awarded the 2004 Nobel Prize in Physics for his contribution to the theory of strong interactions. Following a postdoctoral position at Harvard University, Edward Witten became a professor at Princeton University in 1980 and a professor of mathematical physics at the Institute for Advanced Study in Princeton in 1987.

URL for press release: <http://www.joachim-herz-stiftung.de/presse/pressefotos> A press photo of Edward Witten can be downloaded here.

URL for press release:

<http://www.joachim-herz-stiftung.de/en/about-us/prizes/hamburg-prize-for-theoretical-physics/edward-witten> We introduce the scientist and personality Edward Witten in an interview. He gives us an insight into his highly complex scientific work and divulges what the letter M in M-theory is all about



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