

5 October 2021

The Nobel Prize in Physics 2021

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Physics 2021

“for groundbreaking contributions to our understanding of complex physical systems”

with one half jointly to

Syukuro Manabe **Klaus Hasselmann**

Princeton University, USA

Max Planck Institute for Meteorology,
Hamburg, Germany

and the other half to

Giorgio Parisi

Sapienza University of Rome, Italy

“for the physical modelling of Earth’s climate, quantifying variability and reliably predicting global warming”

“for the discovery of the interplay of disorder and fluctuations in physical systems from atomic to planetary scales”

Physics for climate and other complex phenomena

Three Laureates share this year’s Nobel Prize in Physics for their studies of chaotic and apparently random phenomena. Syukuro Manabe and Klaus Hasselmann laid the foundation of our knowledge of the Earth’s climate and how humanity influences it. Giorgio Parisi is rewarded for his revolutionary contributions to the theory of disordered materials and random processes.

Complex systems are characterised by randomness and disorder and are difficult to understand. This year’s Prize recognises new methods for describing them and predicting their long-term behaviour.

One complex system of vital importance to humankind is Earth’s climate. **Syukuro Manabe** demonstrated how increased levels of carbon dioxide in the atmosphere lead to increased temperatures at the surface of the Earth. In the 1960s, he led the development of physical models of the Earth’s climate and was the first person to explore the interaction between radiation balance and the vertical transport of air masses. His work laid the foundation for the development of current climate models.

About ten years later, **Klaus Hasselmann** created a model that links together weather and climate, thus answering the question of why climate models can be reliable despite weather being changeable and chaotic. He also developed methods for identifying specific signals, fingerprints, that both natural phenomena and human activities imprint in

the climate. His methods have been used to prove that the increased temperature in the atmosphere is due to human emissions of carbon dioxide.

Around 1980, **Giorgio Parisi** discovered hidden patterns in disordered complex materials. His discoveries are among the most important contributions to the theory of complex systems. They make it possible to understand and describe many different and apparently entirely random materials and phenomena, not only in physics but also in other, very different areas, such as mathematics, biology, neuroscience and machine learning.

“The discoveries being recognised this year demonstrate that our knowledge about the climate rests on a solid scientific foundation, based on a rigorous analysis of observations. This year’s Laureates have all contributed to us gaining deeper insight into the properties and evolution of complex physical systems,” says Thors Hans Hansson, chair of the Nobel Committee for Physics.

Syukuro Manabe, born 1931 in Shingu, Japan. Ph.D. 1957 from University of Tokyo, Japan. Senior Meteorologist at Princeton University, USA.

Klaus Hasselmann, born 1931 in Hamburg, Germany. Ph.D. 1957 from University of Göttingen, Germany. Professor, Max Planck Institute for Meteorology, Hamburg, Germany.

Giorgio Parisi, born 1948 in Rome, Italy. Ph.D. 1970 from Sapienza University of Rome, Italy. Professor at Sapienza University of Rome, Italy.

Prize amount: 10 million Swedish kronor, with one half jointly to Syukuro Manabe and Klaus Hasselmann and the other half to Giorgio Parisi

Further information: www.kva.se and www.nobelprize.org

Press contact: Eva Nevelius, Press Secretary, +46 70 878 67 63, eva.nevelius@kva.se

Experts: Thors Hans Hansson, +46 70 376 89 63, hansson@fysik.su.se, Anders Irbäck, +46 73 362 29 60, anders@thep.lu.se and John Wettlaufer, +46 73 244 74 59, john.wettlaufer@su.se, the Nobel Committee for Physics

The Royal Swedish Academy of Sciences, founded in 1739, is an independent organisation whose overall objective is to promote the sciences and strengthen their influence in society. The Academy takes special responsibility for the natural sciences and mathematics, but endeavours to promote the exchange of ideas between various disciplines.

BOX 50005, SE-104 05 STOCKHOLM, SWEDEN
TEL +46 8 673 95 00, kva@kva.se • WWW.KVA.SE
BESÖK/VISIT: LILLA FRESCATIVÄGEN 4A, SE-114 18 STOCKHOLM, SWEDEN



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