

The Legendary Scientific Figure: George parisi

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Abstract

In 2021, the Nobel Prize in Physics was awarded to three physicists who made breakthroughs in understanding complex systems: Syukuro Manabe of Japan, Klaus Hasselmann of Germany and Giorgio Parisi of Italy. This paper mainly introduces the legendary experience of Italian scientist Giorgio parisi, including the promotion of Solvey Conference and his love affair with China.

Keywords

2021 Nobel Prize in Physics; Legendary Experience; Solvay Conference.

1. Introduction to Scientific Figures

On October 5, 2021, the Nobel Prize in Physics was announced. The prize was awarded to scientists Syukuro Manabe, Klaus Hasselmann and Giorgio Parisi for their pioneering contributions to "understanding complex physical systems". It is worth noting that George parisi just won the Wolff Prize in Physics in February of that year, and this time he won the Nobel Prize in Physics, which enriched the legendary experience of George parisi and undoubtedly became a scientific figure of concern in 2021.

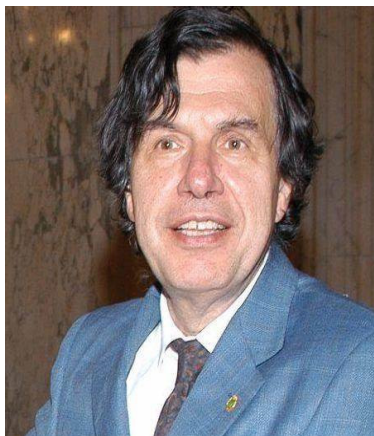


Figure 1. George parisi

George parisi was born in Rome on August 4th, 1948. His father and grandfather were both construction workers. Under the influence of his father and grandfather, young parisi's initial dream was to become an engineer. But later parisi was attracted by the complex abstractions he read in popular science books and math books. "I think I want to do something scientific because it is more challenging," he recalled. Parisi was in a dilemma between physics and mathematics at the University of Rome, when the development of mathematics was relatively perfect. But the field of physics made more remarkable progress in the first half of the 20th century. Parisi decided to study physics. At that time, the highest degree offered by Italy was equivalent to one year of doctoral study. parisi made full use of this year after receiving his

bachelor's degree from the University of Rome, and graduated in 1970 under the guidance of Nicolas Cabibo, the most outstanding theoretical physicist in Rome at that time. From 1971 to 1981, he was a researcher at Frascati National Laboratory. During these 10 years, he first served as a researcher at the National Research Center of the United States (1971-1973), and later as a researcher at INFN (1973-1981), and often exchanged ideas abroad: Columbia University in New York (1973-1974), Bourse-sur-Iftez Institute for Advanced Science (1976-1977), Paris Teachers College (1977-1978). In February 1981, he returned to China as a full professor of theoretical physics at the University of Rome II "Tor Vergata". And continued to work at the University of Rome II for 10 years. In 1992, as a professor of quantum theory, he returned to Pienza in Lhasa, the first university of Rome, until today. During his scientific career, he wrote more than 600 articles and made contributions to scientific conferences, including: Field Theory, Disorder and Simulation (1992); Statistical Field Theory (1988); Spinning glass theory and beyond (1987), etc. George Parisi's research mainly focuses on quantum field theory, statistical mechanics and complex systems. Together with Klaus Hasselmann and Syukuro Manabe, he won the 2021 Nobel Prize in Physics, because he made a pioneering contribution to the theory of complex systems, especially "discovering the interaction of disorder and fluctuation in physical systems from atomic to planetary scale.

2. Summary of Scientific Contributions

George Parisi's scientific contributions mainly focus on the quantum field theory in particle physics, the disorder of complex systems and general statistical physics. In particle physics, Parisi and Altarelli conducted a phenomenological study on the scale of deep inelastic electron scattering under the framework of field theory. This study finally obtained the equation of parton density evolution, namely Altarelli-Parisi Western Equation. It is the basis of perturbation QCD calculation in proton-proton collision, which was verified with very high accuracy in the same experiment that LHC discovered Higgs particles. Based on the analogy of monopole magnetic confinement in superconductors, George Parisi introduced the quark-confined flux tube model, which is similar to the confinement of magnetic monopoles in superconductors when the flux tube was formed. This model is often used as a simple explanation for quark confinement. In the aspect of disordered systems, Parisi introduced symmetric group $O(n|n)$ in the framework of Anderson localization, which was the starting point of most subsequent studies. Together with Kardar-Zhang, a model of surface growth in random media (or in the presence of random deposition) is introduced, which has become the standard model of physical complex systems. In the following years, the technology developed from this model was widely spread to many different research fields (such as neural network, optimization theory, glass physics). Among them, Parisi also made an important contribution to the study of finite-dimensional spinning glass system. Together with Mezard, he calculated the thermodynamic behavior in the glass phase of soft balls by first principles, and these balls were later extended to binary mixtures and hard balls by him and Zamponi. In 2015, George Parisi and his collaborators have been able to define and solve the mean field theory of hard sphere interference by considering the hard sphere fluid in infinite dimensional limit. In the field of phase transition and statistical mechanics, George Parisi's main discoveries include: conformal bootstrap framework for calculating key exponents. Using renormalization group theory instead of ϵ expansion, a new method for finding critical index is developed. The adjustment of Migdal-Kadanov approximation by calculating the critical exponent in a systematic way. Using the supersymmetry of stochastic differential equations derived previously, the critical index of branched polymers can be accurately calculated. The concepts of turbulence multifractal and strange attractor are introduced. Multifractal has been widely used in many disciplines of physics since then. In addition, George Parisi and his collaborators were the first people to obtain three-dimensional behavior data of large animal groups recently.

They measured the three-dimensional position of flocks of starlings. Only a few thousand birds were observed at the same time, which expanded the previous measurement results by two orders of magnitude. The developed technology opens up the possibility of quantitative research on the collective three-dimensional behavior of large animal groups.

3. Promoter of Solvay Conference



Figure 2. 24th Solvay Conference in 2008



Figure 3. 25th Solvay Conference in 2011

Solvey Physics Conference is the most famous scientific conference in the world. It was sponsored by Belgian entrepreneur Solvi and held its first conference in Brussels in 1911. It was held every three to five years except for two world wars. At present, it has been held for 27 consecutive sessions (2017), and the 28th Solvay Conference will be held on May 19-21, 2022.

Solvey Conference is devoted to discussing the key problems to be solved in the development of physics. Only a small number of scientists from all over the world discuss a special topic. Every session is a scientific feast, the most famous of which is the fifth Solvey Conference in 1927, especially the great debate between Einstein and Bohr. George parisi first came into contact with Solvey Conference from his teacher Nicola Cabibo, who attended the 14th Solvey Conference held in 1967. At that time, the theme was the basic problems of elementary particle physics. After World War II, physics showed various developments, the most important of which was the development of elementary particle physics and high-energy physics, especially the construction of large particle accelerators, and a new particle was discovered almost every week. George parisi formally grew up in this context. In 2008, George parisi, who is already a world-renowned scientist, joined the Scientific Committee of the International Solvey Conference, and participated in the 24th Solvey Conference for the first time (the third right in the second row in Figure 2 is parisi on the right hand side of Wen Xiaogang). He continued to serve in the following 25 sessions (2011, the third right in the second row in Figure 3), the 26th session (2014) and the 27th session (2017). Contributed to the promotion and development of Solvay Conference.

4. Love with China



Figure 4. Wu Yongshi and parisi

In 1978, the Institute of Theoretical Physics of Chinese Academy of Sciences was established, and Wu Yongshi was transferred to the Institute of Theoretical Physics with Room 13 of the Institute. Since its establishment, the Institute of Theoretical Physics has attached great importance to open communication. At that time, Mr. Hao Bailin and Mr. Yu Lu invited a young peer expert Edouard Brezin (Brezin France (Brezin later became the president of the French Academy of Sciences)). Under the introduction of Brezin, Wu Yongshi and parisi got to know each other and forged a profound friendship. Parisi came to the Institute of Theoretical Physics of Chinese Academy of Sciences as a visiting professor in the spring of 1980 (April-May). During the short two-month visit, parisi cooperated with Wu Yongshi to complete his paper Perturbation Theory Without Gauge Fixing, which was mentioned in the Nobel Prize Colloquium. After the paper was completed, in order to make more people read this article, Wu

Yongshi hoped to publish it in foreign journals. Parisi insisted on publishing it in an academic journal in China. He said that this was his first visit to China and he was willing to publish the article in China as a commemoration of his visit to China. Finally, this paper was published in China Science in 1981. Parisi is very interested in the culture of China. Before he came to China, he had taught himself Chinese for at least half a year. After he came to China, he could simply communicate in Chinese. Parisi keeps in touch with the Institute of Theoretical Physics, including academicians Hao Bailin and Yu Lu. In 2006, the Institute of Theoretical Physics of China Academy of Sciences set up the caffery theoretical physics exchange and cooperation platform. In March 2008, parisi came to caffery to participate in the scientific research project of "Collective Dynamics of Information Systems" and taught a series of statistical physics courses for graduate students. In the following years, at the invitation of researchers from the Institute of Theoretical Physics, parisi also visited the Institute of Theoretical Physics for many times.

5. Grand Slam Winner of Physics Prize

George parisi won numerous awards in his legendary scientific career. First, he won the Feltrinelli Prize in Physics in 1987. Then, in 1992, he was awarded the Boltzmann Medal for his contribution to the theory of disordered systems (which was awarded every three years by the International Physics Society). Later, he won the Gass Prize in Ital in 1993 and the Dirac Medal for Theoretical Physics (the highest prize in theoretical physics) in 1999. He won the Enrico Fermi Award in 2003, the Danny Heinemann Award in 2005, the Galileo Award in 2006, the Lagrange Award in 2009, and the Max Planck Medal of the German Physical Society in 2011. In 2013, he won the Italian natural science tutor award, and in 2015, he won the-High Energy and Particle Physics Award-EPS HEPP Award. In 2016, he won the Lars Onsager Prize. In 2018, he won the Pomei Lanik Prize. In February 2021, he won the Wolf Prize in Physics (the highest prize except the Nobel Prize). In October 2021, he won the Nobel Prize in Physics. The Nobel Prize can be said to make Parrich a grand slam winner of the physics prize, which undoubtedly enriched Parrich's legendary scientific experience.

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