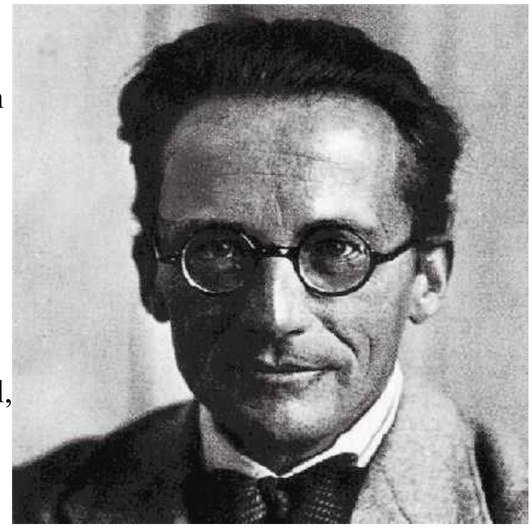
Erwin Schrödinger



In 1926 physicist **Erwin Schrödinger** (August 12, 1887 – January 4, 1961) published four papers that laid the foundation of the wave behavior of matter within quantum mechanics. He tied the so-called *Schrödinger's equation* to almost every aspect of physics, making it the fundamental equation of quantum mechanics. An extremely powerful mathematical tool, it determines the behavior of the wave function that describes the wavelike properties of a subatomic system. In general, quantum mechanics does not predict a single definite result for an observation. Instead, it predicts a number of different possible outcomes and gives the probabilities of these outcomes. As well as enabling the energy of electrons to be calculated, the also gives a probability distribution known as the *wavefunction*, which is represented by the Greek letter psi (*ψ).* For several years there wasn't any general agreement as to what the wavefunction actually was. A student of , Walter Huckel, composed the following poem, translated by Felix Bloch concerning the confusion.

Erwin with his psi can do
Calculations quite a few.
But one thing has not been seen
Just what does psi really mean.

The wave function enables the probability of an electron being at a particular place at a particular time to be predicted. This enables the likely position of an electron in the field of a nucleus to be calculated, enabling the shape of the orbitals that electrons occupy in atoms to be determined. The wave equation can be expressed by $i\hbar\, \partial\psi/\partial t = (-\, \hbar^2/2m)\, \partial^2\psi/\partial x^2 + V(x)\psi(x,t)$, where i is the imaginary unit, $\sqrt{-1}$, x represents position, h is the Planck constant divided by 2π, ψ is the *wave function,* defined over space and time. The equation provided a theoretical basis for the atomic model that Bohr had proposed based on laboratory evidence. made the second theoretical explanation of electrons in an atom, following Werner Heisenberg's matrix mechanics; but in most cases Schrödinger's approach and mathematics were much simpler for physicists to understand and use was awarded the Nobel Prize for Physics.

Schrödinger was born in Vienna. His father owned an oilcloth factory and was an amateur painter and botanist. Erwin was taught at home until he was eleven. He attended the Gymnasium, where he excelled in all subjects but he especially loved mathematics and physics. His only complaint about school was that he abhorred memorizing dates and facts from books. From 1906 to 1910 he was a student at the University of Vienna where he made an extensive study of mathematics and was inspired by the brilliant young theoretical physicist Friedrich Hasenöhrl. Schrödinger was awarded a doctorate in physics for his thesis *On the conduction of electricity on the surface of insulators in moist air*. He completed his habilitation and took a position with the University. During WWI he served as an artillery officer at an isolated fort in Hungary, which gave him time to continue his studies and research. During the war l was killed, and in his Nobel Prize speech, graciously remarked that had his teacher survived the war, he would have received the Nobel Prize instead.

In 1920 Schrödinger took an academic post as assistant to Max Wein at Jena and married Anny Bertel. They remained married for nearly forty-one years, despite the fact that he had numerous lovers and she carried on a long-term affair with Schrödinger's friend André Weil. In 1933 Schrödinger fell in love with Hilde March, the wife of his assistant Arthur March. For a period of time, Schrödinger lived openly with the two women, having a daughter with each. Later he had two more daughters with two other women. After 1920, there was a period of moving from one academic position to another. This was in part due to Schrödinger's desire to find his niche among theoretical physicists, but there was also a financial reason. He rejected an associate professorship at Vienna because its yearly salary was less than Anny made in a month as a secretary. Finally he was appointed to the chair of theoretical physics at Zurich (1921), where he remained for six fruitful years, actively engaged in a variety of areas of theoretical physics.

When Max Planck retired from the University of Berlin, Schrödinger succeeded him. Before long the Nazi menace became serious and Schrödinger sadly saw many friends and colleagues forced to resign their university positions and leave the country because they were Jewish. Although Schrödinger was a Catholic, when Hitler became Germany's chancellor, Erwin left the country. He went to Oxford University in England, but homesick, after three years he returned to Austria to take a post at the University of Graz. When Germany annexed Austria, his earlier departure from Germany was viewed by the Nazi regime as an unfriendly act. He was dismissed from his professorship for "political unreliability." He fled to Italy and from there to Princeton University in the United States. Shortly afterwards, Eamon de Valera, Prime Minister of Ireland and formerly a mathematics teacher, invited to assume the position of Director of the School for Theoretical Physics at the newly created Institute for Advanced Studies in Dublin. accepted and continued his studies of the application and statistical interpretation of wave mechanics, the mathematical character of the new statistics, and the relationship of this statistics to statistical thermodynamics. He remained at Dublin until his retirement in 1956 and then spent the last few years of his life in an honored position in Vienna.

Schrödinger published "The present situation in quantum mechanics" (1935) in which he devised an experiment to illustrate how radically the quantum realm differs from the everyday world. He earlier had shown that a particle such as an electron exists in a number of different states, the probability of each of which is incorporated into a wave function. For instance an atom of radioactive material has a certain probability of decaying over a given period of time. Intuitively we might conclude that for a particular atom it either has decayed or it has not. However, in quantum physics, the atom can be both at the same time.

To demonstrate, Schrödinger proposed the following experiment. A living cat is placed in a thick lead box containing a device that can release cyanide gas, instantly killing the cat. Once the box is sealed, the device is triggered by a random event – the radioactive decay of an atom. For the purpose of the experiment, it is assumed that the probability of the atom decaying in one hour is one half. According to classical physics, the cat in the box is either dead or alive depending on whether or not the decay has occurred. The paradox arises because the atom, being a microscopic object, must be described by quantum mechanics. As far as the experimenters know the cat is in a kind of limbo, because they don't know if the atom has decayed unless the box is opened. According to quantum mechanics, the cat is both dead and alive, two contradictory states existing simultaneously. It is only the act of opening the box that determines whether the cat is dead or alive.

Quotation of the Day: "Thus, the task is not so much to see what no one has seen, but to think what nobody has yet thought, about that which everybody sees." – Erwin Schrödinger