University of Zurich[UZH]

Max von Laue

Nobel Prize in Physics 1914

Nobel Prize in Physics 1914 "for his discovery of the diffraction of X-rays by crystals"

* 9 October 1879 in Pfaffendorf, Germany
† 24 April. 1960 in West Berlin

1912–1914 Professor of Theoretical Physics at the University of Zurich

Dual Accolades: Noble and Nobel

Max Laue arrived Zurich in October 1912 to commence the first professorship of his academic career. Just prior to receiving his appointment, this career had gained considerable momentum: In the spring of the same year, at Arnold Sommerfeld's institute in Munich, Laue had conducted the revolutionary experiments that made him famous in the world of physics – and that very quickly brought him the Nobel Prize. This rate of progress suited him well; Laue loved speed: Not only was he a quick thinker, he was also "devilishly fond" of cars.

With the legendary Munich experiments, Laue, a mathematician and a physicist, solved in a single stroke two problems that had stymied researchers at the beginning of the 20th century. He clarified the nature of X-rays by showing that, like light, they were electromagnetic waves, and he opened the door for entirely new insights into the atomic structure of matter. Wilhelm Conrad Röntgen had already discovered his famous X-rays in 1895, but the nature of these rays had remained a mystery until Laue arrived on the scene. Proponents of the corpuscular theory maintained that the rays were particles whirling through space. The opponents of this theory, including Laue, believed them to be electromagnetic waves, similar to light. Laue was able to demonstrate that wave theory was indeed applicable to X-rays. The unknown X was thus resolved.

To prove his theory, Laue and his two laboratory assistants, Walter Friedrich and Paul Knipping, beamed X-rays through a copper sulfate crystal. Then, in the spring of 1912, what the scientific world had long been seeking became visible on a photographic plate mounted behind the crystal. Around the main beam of X-ray light, appearing as large dark spot on the plate, a pattern formed of much smaller spots, some darker, some lighter. They stemmed from the X-rays, which – like visible light through a prism – had been diffracted by the atoms of the crystal. It thus became evident that this was an image of very short-wavelength light.

But not only that: On the basis of Laue's discovery, British scientists William und Lawrence Bragg were soon able to demonstrate that the pattern left by the diffracted rays represent a sort of atomic fingerprint of the crystal. The analysis of this specific pattern enabled the researchers to arrive at precise conclusions about the spatial structure of a crystal. Max Laue's discovery thus laid the foundations for the analytic processes in X-ray crystallography, processes that are today indispensable for research in biology, chemistry, and materials science.

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When Max Laue moved to Switzerland in the fall of 1912, his historic discovery was still very new. He revealed it to the general public in Zurich in his inaugural lecture on the topic of "The wave theory of Röntgen Rays" on 14 December 1912.

Peter Debye had proposed Laue for the chair for theoretical physics, which Debye wished to vacate. However, the Zurich delegation that traveled to Munich in the spring of 1912 – just at the time of Laue's revolutionary experiments – to listen to the young scientist lecture, were not particularly impressed. The experts reported that

Laue came across as well prepared, but that he spoke quickly, quietly, and not very clearly. They nevertheless took the view that these shortcomings could be overcome with time, and nothing more stood in the way of Max Laue's appointment.

During the two years he spent in Zurich, Max Laue continued to hone his theory. Practical research, however, was somewhat hindered by a shortage of funds. For instance, Laue lacked the means to finance a sufficient number of X-ray tubes for his experiments. Moreover, an application for an assistant to relieve him of his many duties was unceremoniously rejected by the Zurich authorities. On 14 July 1914, Laue resigned his position at the University of Zurich in order to accept a professorship in Frankfurt am Main – and subsequently found himself in the middle of the war. The war was also the reason that the Nobel Prize for 1914 was only announced the following year. Yet before entering the ranks of scientific nobility, von Laue had already risen to the rank of nobility during his time in Switzerland. His father, a German officer, had been granted a hereditary title in 1913, and Max Laue left Zurich as Max von Laue. *Roger Nickl*

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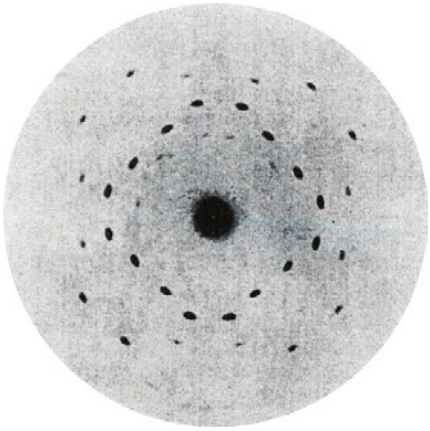
Source: Margrit Wyder: *Einstein und Co. – Nobelpreisträger in Zürich*; Verlag NZZ libro, Zürich 2015 **Illustration:** Aline Telek
Translation: University of Zurich

Explained the nature of X-rays and established the field of X-ray crystallography: Max von Laue



Max von Laue discovered that X-rays beamed through a crystal onto a photographic plate acquire a clear diffraction pattern.