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Klaus Von Klitzing

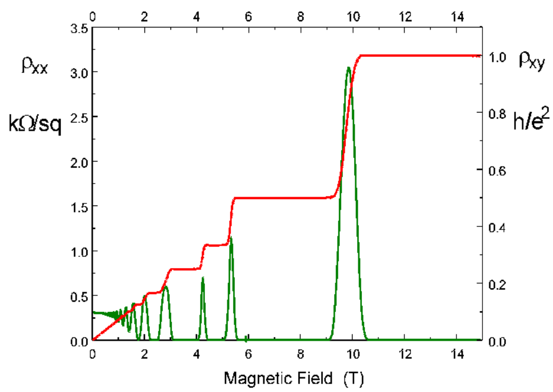
During his Nobel Prize acceptance speech in 1985, twenty two year old German physicist Klaus von Klitzing acknowledged the "recognition of the fundamental nature of semiconductor physics" that accompanied his Nobel Prize "for the discovery of the quantized Hall effect." Despite facing many challenges as a child growing up during the height of the Second World War, Klitzing managed to utilize his education to the highest potential. Throughout his lifetime Klitzing has obtained numerous honors and achievements, including the Walter Schottky Prize, the Hewlett-Packard Prize, and the distinguished Nobel Prize in Physics.

Von Klitzing was born on June 29, 1943 to German parents Bogislav von Klitzing and Anny Ulbrich. As a young child, Klitzing's family relocated due to the tribulations of the Second World War. Due to the invasion of the Soviet army towards the end of the War, the Klitzings relocated numerous times, notably residing in the German towns of Lutten and Oldenburg, ultimately ending up in Essen. Von Klitzing later attended the Artland Gymnasium. Throughout his education, Klitzing displayed proficiency in mathematics and sciences, lending to his decision to major in Physics.

Klitzing graduated in 1969 from the Technical University of Brunswick with a bachelor's degree in physics. Klitzing then went on to obtain a doctorate in physics from the University of Würzburg in 1972. Studying under Dr. G. Landwehr, Klitzing expanded his interests and became particularly interested in the effects of magnetism on semi-conductors. In 1971, Klitzing published his first paper relating to the effects of magnetic fields on semi-conductors, entitled "Resonance structure in the high field magneto resistance of tellurium", with which he wrote with his mentor Dr. G. Landwehr. In order to obtain his Ph.D., Klitzing did his graduate research on "Galvanomagnetic Properties of Tellurium in Strong Magnetic Fields".

Klitzing continued his post-graduate research at the University of Würzburg, until his experiments called for more sophisticated and expensive equipment. In 1975 and 1976, Klitzing researched at the Clarendon Laboratory at Oxford University due to the presence of powerful superconducting magnets. After completing his studies at Oxford, Klitzing returned to the University of Würzburg. The question of funds to produce a stronger magnetic field occurred

Figure 1



one more, leading Klitzing to move to the High Magnetic Field Laboratory at the Institute Max von Laue-Paul Langevin in Grenoble, France. It is here that Klitzing discovered the Hall Effect and founded the Von Klitzing constant, name after Von Klitzing himself.

In 1879, American physicist Edwin Herbert Hall discovered the "development of a transverse electric field in a solid material when it carries an electric current and is placed in a magnetic field that is perpendicular to the current". When studying the hall resistance, Klitzing realized that when the magnetic field strength increased, Hall resistance would increase, remain constant for a short amount of time, and then do the same multiple times. Graphed, the observations made by Klitzing are expressed in Figure 1. Prior to Klitzing's discovery, the Hall

Effect dictated a straight line, unlike the staircase type graph discovered by hall. While attempting to explain this phenomenon, Klitzing discovered what would later be known as the Klitzing Constant.

In order to keep measurements precise, Klitzing observed two dimensional sheets of thin, current-carrying pieces of metal between the poles of a strong magnet. Klitzing first used a thin sheet of silicon chilled to the temperature of almost absolute zero. After applying the magnetic field, Klitzing observed the same staircase like graph as Figure 1, but noticed an important observation. Klitzing observed that the steps in the graphed occurred at a constant value of 25,813 ohms, also the exact ratio of the electrical charge of an electron squared in relation to the Plank's constant. After repeating the experiment multiple times on two dimensional objects at absolute zero, Klitzing realized the precision of the steps on the graph. He then assigned an equation to the constant, R_k denoting the von Klitzing constant. The equation of the von Klitzing Constant can be seen in Figure 2.

$$\boldsymbol{R_K = h/e^2 = 25812.807557(18)\ \Omega}$$

Figure 2

This equation can be used to prove that electrical resistance happens in precise units. The studies concluded in 1980. Afterward, his findings were immediately recognized, as the enabled one to study the conducting properties of electronic components with considerable amounts of precision. It also allowed scientists established a standard for the measurement of electrical resistance, the ohm. Klitzing's discovery revolutionized the study of electrical resistance, as it resulted in a way to measure electrical resistance. In 1982, outside researchers in New York discovered that the von Klitzing constant applied not only to integers, but also to fractions. This brought Klitzing back into the eyes of the public, garnering him enough recognition to obtain his Nobel Prize in 1985, five years after his initial discovery.

Due to his studies of the Hall Effect and the founding of the von Klitzing Constant, Klitzing obtained the Walter-Schottley Prize in 1981, the Hewlett Packard Prize in 1982, and the Nobel Prize in 1985. In 1980, von Klitzing moved from the University of Würzburg to the Technical University in Munich, Germany. In 1985, the same year Klitzing won his Nobel Prize in Physics, Klitzing became the director of the Max Plank Institute for Solid Research in Stuttgart, Germany, giving him access to the equipment needed to continue his research with magnetic fields. Since then, Klitzing has maintained his position as director of the Max Plank Institute for Solid Research and is continuing his work on low dimensional electronic systems.

Bibliography

"Curriculum Vitae." *Klaus Von Klitzing* -. N.p., n.d. Web. 23 Jan. 2013.

"German Nobel Laureates." *Research in Germany: Land of Ideas*. N.p., 12 Jan. 2012. Web. 23 Jan. 2013.

"Hall effect". *Encyclopædia Britannica. Encyclopædia Britannica Online* Encyclopædia Britannica Inc., 2013. Web. 23 Jan. 2013

"Klaus von Klitzing". *Encyclopædia Britannica. Encyclopædia Britannica Online.* Encyclopædia Britannica Inc., 2013. Web. 23 Jan. 2013

"Klaus Von Klitzing." *Klaus Von Klitzing*. N.p., 2003. Web. 23 Jan. 2013.

"World Biography." *Klaus Von Klitzing Biography*. N.p., n.d. Web. 23 Jan. 2013.