

## **Nobel Prize in Physics 2009**



**Charles Kuen Kao**



**Willard S. Boyle**



**George E. Smith**

The Nobel Prize in Physics 2009 was divided, one half awarded to Charles Kuen Kao "for groundbreaking achievements concerning the transmission of light in fibers for optical communication", the other half jointly to Willard S. Boyle and George E. Smith "for the invention of an imaging semiconductor circuit – the CCD sensor".

### **Information about winners:**

#### **Charles K. Kao**

Standard Telecommunication Laboratories, Harlow, UK, and Chinese University of Hong Kong

#### **Willard S. Boyle and George E. Smith**

Bell Laboratories, Murray Hill, NJ, USA

### **Summary of research work:**

#### **The masters of light**

This year's Nobel Prize in Physics is awarded for two scientific achievements that have helped to shape the foundations of today's networked societies. They have created many practical innovations for everyday life and provided new tools for scientific exploration. In 1966, Charles K. Kao made a discovery that led to a breakthrough in fiber optics. He carefully calculated how to transmit light over long distances via optical glass

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fibers. With a fiber of purest glass it would be possible to transmit light signals over 100 kilometers, compared to only 20 meters for the fibers available in the 1960s. Kao's enthusiasm inspired other researchers to share his vision of the future potential of fiber optics. The first ultrapure fiber was successfully fabricated just four years later, in 1970.

Today optical fibers make up the circulatory system that nourishes our communication society. These low-loss glass fibers facilitate global broadband communication such as the Internet. Light flows in thin threads of glass, and it carries almost all of the telephony and data traffic in each and every direction. Text, music, images and video can be transferred around the globe in a split second.

If we were to unravel all of the glass fibers that wind around the globe, we would get a single thread over one billion kilometers long – which is enough to encircle the globe more than 25 000 times – and is increasing by thousands of kilometers every hour.

A large share of the traffic is made up of digital images, which constitute the second part of the award. In 1969 Willard S. Boyle and George E. Smith invented the first successful imaging technology using a digital sensor, a CCD (Charge-Coupled Device). The CCD technology makes use of the photoelectric effect, as theorized by Albert Einstein and for which he was awarded the 1921 year's Nobel Prize. By this effect, light is transformed into electric signals. The challenge when designing an image sensor was to gather and read out the signals in a large number of image points, pixels, in a short time. The CCD is the digital camera's electronic eye. It revolutionized photography, as light could now be captured electronically instead of on film. The digital form facilitates the processing and distribution of these images. CCD technology is also used in many medical applications, e.g. imaging the inside of the human body, both for diagnostics and for microsurgery.

Digital photography has become an irreplaceable tool in many fields of research. The CCD has provided new possibilities to visualize the previously unseen. It has given us crystal clear images of distant places in our universe as well as the depths of the oceans.

**[For more details please visit:](#)**

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