

# The Nobel Prize in Physics 2009

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Physics for 2009 with one half to

**Charles K. Kao**

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

*“for groundbreaking achievements concerning  
the transmission of light in fibers for optical communication”*

and the other half jointly to

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

Bell Laboratories, Murray Hill, NJ, USA

*“for the invention of an imaging semiconductor circuit –  
the CCD sensor”*

## 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 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.

---

**Charles Kuen Kao**, British and US citizen. Born 1933 in Shanghai, China. Ph.D. in Electrical Engineering 1965 from Imperial College London, UK. Director of Engineering at Standard Telecommunication Laboratories, Harlow, UK. Vice-chancellor, Chinese University of Hong Kong. Retired 1996.

[www.ieeeeghn.org/wiki/index.php/Oral-History:Charles\\_Kao](http://www.ieeeeghn.org/wiki/index.php/Oral-History:Charles_Kao)

**Willard Sterling Boyle**, Canadian and US citizen. Born 1924 in Amherst, NS, Canada. Ph.D. in Physics 1950 from McGill University, QC, Canada. Executive Director of Communication Sciences Division, Bell Laboratories, Murray Hill, NJ, USA. Retired 1979.

[www.science.ca/scientists/scientistprofile.php?plD=129](http://www.science.ca/scientists/scientistprofile.php?plD=129)

**George Elwood Smith**, US citizen. Born 1930 in White Plains, NY, USA. Ph.D. in Physics 1959 from University of Chicago, IL, USA. Head of VLSI Device Department, Bell Laboratories, Murray Hill, NJ, USA. Retired 1986.

[www.ieeeeghn.org/wiki/index.php/Oral-History:George\\_E.\\_Smith](http://www.ieeeeghn.org/wiki/index.php/Oral-History:George_E._Smith)

**The Prize amount:** SEK 10 million. Kao is awarded one half, Boyle and Smith share the other half.

**More information:** <http://kva.se> and <http://nobelprize.org>

**Contacts:** Erik Huss, Press Officer, Phone +46 8 673 95 44, +46 70 673 96 50, [erik.huss@kva.se](mailto:erik.huss@kva.se),  
Annika Moberg, Editor, Phone +46 8 673 95 22, Mobile +46 70 263 74 46, [annika.moberg@kva.se](mailto:annika.moberg@kva.se)

The Royal Swedish Academy of Sciences, founded in 1739, is an independent organization whose overall objective is to promote the sciences and strengthen their influence in society. The Academy takes special responsibility for the natural sciences and mathematics, but endeavours to promote the exchange of ideas between various disciplines.

BOX 50005, SE-104 05 STOCKHOLM, SWEDEN

TEL +46 8 673 95 00, FAX +46 8 15 56 70, [INFO@KVA.SE](mailto:INFO@KVA.SE) • [HTTP://KVA.SE](http://KVA.SE)

BESÖK/VISIT: LILLA FRESCATIVÄGEN 4A, SE-114 18 STOCKHOLM, SWEDEN



KUNGL.  
VETENSKAPS-  
AKADEMIEN

THE ROYAL SWEDISH ACADEMY OF SCIENCES