

The Father of X-Ray Astronomy



One of the three Nobel Prize laureates in physics in 2002 was the Italian-born scientist Riccardo Giacconi: he discovered the first X-ray sources outside our solar system and developed the first X-ray telescope. He also made a major contribution to NASA's X-ray satellite "Chandra," in which "Zerodur" was used as a mirror substrate.

► X-rays were discovered in 1895 by the German physicist Wilhelm Conrad Rontgen, who received the Nobel Prize for his discovery in 1901. However, it took nearly half a century to prove the presence of X-rays in outer space. The main reason for this is that this type of radiation is almost completely absorbed by the Earth's atmosphere. By using rockets and special balloons, it finally became possible to transport instruments far enough into the stratosphere to measure extraterrestrial X-rays.

U.S. astrophysicist Herbert Friedman provided the first evidence thanks to a German V2 rocket carrying several special radiation detectors on board. With their help he was able to prove the existence of X-rays from the hot luminous ring appearing to surround the sun called the corona. In 1962 Riccardo Giacconi then made a pioneering discovery. He and his co-workers had actually hoped to detect the solar X-rays scattered by the moon. They did not succeed in establishing this effect with their rocket experiment, but completely unexpectedly, they were able to discover a very strong X-ray source in the constellation called Scorpius. Today, practically all astronomers know this source as "SCO X-1." The research team also determined diffuse X-rays distributed throughout the sky.

UHURU detects X-ray sources

These unexpected discoveries were the starting point of experimental X-ray astronomy. Increasing numbers of researchers worked in this field, and thus more and more X-ray sources were discovered in outer space. With the rocket experiments at that time, however, it was very difficult to investigate these objects in detail as the observation times were simply too short. Thus Giacconi began to construct a satellite that would

be able to continuously search the sky for X-ray sources. He completed his project in 1970: the satellite called UHURU (which means freedom in Swahili) was launched into space from a rocket station in Kenya. Within just one week, he discovered more X-ray sources than had been found in all prior experiments.

X-ray telescope supplies sharp images

With the so-called "Einstein telescope" Giacconi also designed the first instrument that was not only able to detect X-ray sources, but could also make them visible in relatively sharp photographs. Based on an idea developed by the German physicist Hans Wolter in 1951, the "soft" X-ray light of the stars could be photographed using a system of tube-shaped, parabolically and hyperbolically curved mirrors. The radiation is thereby reflected at grazing incidence at their inner sides, while in the case of normal incidence optics like lenses or mirrors, the radiation would be completely absorbed. This kind of mirror system was realized for the first time in the "Einstein telescope," which began operations in outer space in 1978. With this technology, astronomers were finally able to analyze the X-ray sources with greater precision. They then discovered, for example, that a neutron star is present in most double star systems, and they were also able to observe the remains of supernova explosions.

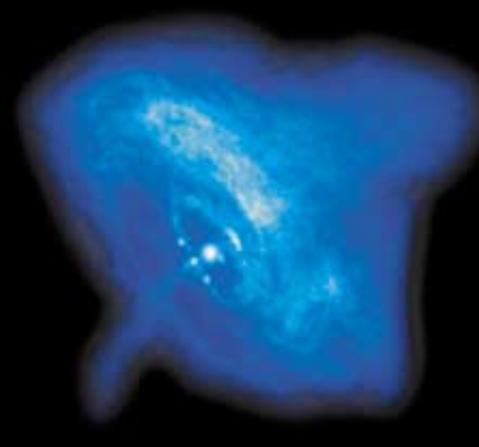
In 1976 Giacconi already started designing a still bigger and more powerful X-ray telescope. Named after the Indian astrophysicist and Nobel Prize laureate Subrahmanyan Chandrasekhar, "Chandra" was eventually launched into outer space in 1999. With its high-resolution mirror system made from the glass ceramic "Zerodur," Chandra supplies photographs with ten times more detail than its predecessors and is thus helping scientists gain a better understanding of the structure and development of stars and galaxies. ◀

Riccardo Giacconi

Riccardo Giacconi was born in Genoa, Italy, in 1931. He began his scientific career in Milan, where he wrote his



Ph.D. thesis on the subject of cosmic radiation. In 1959 he left for the United States to work at the private research institute American Science and Engineering Corporation (ASE). Giacconi joined the faculty of Harvard University in 1973 and became the first director of the Space Telescope Science Institute in 1981, which supervised the scientific program of the Hubble Space Telescope. He was General Director of the European Southern Observatory in Garching near Munich from 1993 to 1999. Giacconi returned to the United States in 1999 and since then has been President of the Associated Universities Inc. (AUI) in Washington. He is also employed as a research professor at the John Hopkins University in Baltimore, Maryland. He is now a U.S. citizen.



The "crab nebula" photographed by Chandra: the remains of an exploding supernova are more than 6,000 light years away in the constellation Taurus.