

Obituary

Johannes A. van Paradijs (1946–99)

Jan van Paradijs, who died in Amsterdam on 2 November, was one of the world's foremost astrophysicists. He will probably be remembered most for the discovery, in 1997, of the first optical afterglow of a γ -ray burst, which established the extragalactic nature of these bursts and solved what had for some 25 years been one of the greatest problems of astrophysics. Because of this first optical sighting, which has since been followed by a dozen others, we now know that γ -ray bursts occur in very distant galaxies and represent the largest explosions of energy in the Universe since the Big Bang.

Born into a bricklayer's family in Haarlem, The Netherlands, van Paradijs was the eldest of seven children. Thanks to the intervention of the headmaster of his Roman Catholic primary school, his parents sent him to a Haarlem secondary school that prepares students for higher education. In 1963 he began studying mathematics, physics and astronomy at the University of Amsterdam. He excelled in all three fields and graduated in 1970. During those years he played top-league basketball for his home town Haarlem. He also took many university classes in philosophy, and clear logic and consistent reasoning became second nature to him in all his activities. Later, he would teach these qualities, both in words and by example, to students and colleagues.

Van Paradijs carried out his PhD research on the structure and chemical composition of cool giant stars under the guidance of David Koelbloed. The knowledge he gained in stellar spectroscopy and photometry, as well as in the theory of stellar atmospheres, prepared him well for his later research on X-ray binaries and neutron stars. When I came to Amsterdam in 1974, he had just become a tenured research associate and decided to join me in studies of binary X-ray sources, complementing my theoretical work with careful observations.

X-ray binaries are the strongest sources of X-rays in the Galaxy, in which gas flows from a normal star to a nearby compact companion, such as a neutron star or black hole. Van Paradijs carried out systematic studies of the orbits and light curves (variation of light over time) of the normal stars in these systems, with the aim of accurately determining the mass of a companion neutron star. As their name suggests, neutron stars consist almost entirely of neutrons and so are very dense and small.



High-energy astrophysicist who hunted big astronomical game

In 1975 van Paradijs succeeded in measuring the first ever mass of a neutron star: Vela X-1. This neutron star is about twice as heavy as the Sun, but has a diameter of only about 20 km. He realized the great importance of these accurate mass determinations for fundamental physics. Together with radius measurements of neutron stars — a topic he addressed in later studies of X-ray burst sources — they are the only way to study nuclear matter at densities far beyond what can be reached in the laboratory.

From 1977 to 1979 van Paradijs worked at MIT, where he became interested in X-ray bursts — powerful, brief outbursts of X-rays that were discovered by a Dutch satellite in 1975. Colleagues at MIT, George Clark, Walter Lewin and Paul Joss, were using a small astronomy satellite to observe such X-ray bursts and made many important discoveries. His close friendship with Walter Lewin dated from this time — they produced over 120 papers together, out of 400 or so scientific papers van Paradijs produced during his lifetime.

A trait of van Paradijs' work was his talent for seeing the 'big picture' through a multitude of often confusing observational facts. A prime example was his demonstration that X-ray burst sources are neutron stars and not black holes as had been generally thought. He showed that the peak luminosities of many bursts were always the same, leading to the idea of a

'standard candle'. From this he was able to measure the diameters of several burst sources, and found them all to be about 16 km, typical of a neutron star. Among his other discoveries were the demonstration that X-ray-burst sources are members of binary systems, and the first spatially resolved spectroscopic mapping of an accretion disk that forms between two stars in a low-mass binary.

In 1978, while working at the European Southern Observatory in Chile, together with Holger Pedersen from Copenhagen, van Paradijs discovered the first optical flash from an X-ray burst, by simultaneously combining telescope and satellite data. Such simultaneous observations of unpredictable, brief events require much organization and a flair for logistics. There can be no doubt that van Paradijs' expertise in this area gave him a head start over other groups when in 1996 the BeppoSAX satellite began to provide accurate positions of γ -ray bursts. It was therefore no coincidence that, together with his students Paul Groot and Titus Galama, he was the first to detect the optical afterglow from a γ -ray burst and to establish its extragalactic nature.

Jan van Paradijs married the Greek astrophysicist Chryssa Kouveliotou in 1992. She works at NASA's Marshall Space Flight Center in Huntsville, Alabama, where from 1993 Jan was a part-time physics professor at the University of Alabama. He divided his time between Huntsville and Amsterdam, where he was also a professor. The marriage was a very happy one, each partner strongly supporting the other in research as well as in personal life. He was co-author on her 1998 paper reporting the discovery of magnetars — neutron stars with giant magnetic fields of 10^{15} Gauss — just as she was co-author on his paper reporting the discovery of the first γ -ray-burst afterglow. All in all, in the last eight years they published more than 90 papers together.

It came as a great shock that at the peak of their careers, Jan suddenly appeared to be gravely ill. During the past seven months Chryssa practically suspended her career to care for him until the end. Van Paradijs guided the research of over 25 PhD students in Amsterdam and Huntsville. He will be remembered by them all as an outstanding scientist and teacher, and a fine colleague and friend.

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