Obituary: Jürgen Ehlers

Jürgen Ehlers, one of the most distinguished and influential German scientists of his generation, died very suddenly and unexpectedly on 20 May 2008. A specialist in the study of general relativity, and at the same time a generalist and humanist with a passion for the fundamentals of the natural world, Ehlers played a leading role in the revival of research in general relativity in modern Germany from its small beginnings in the 1950s through to the flowering of the subject during the past decade. The institute he founded in Potsdam in 1995, the Max Planck Institute for Gravitational Physics (more commonly known by its subsidiary name, the Albert Einstein Institute – AEI), has become the largest institute of its kind in the world. It is a fitting memorial to his scientific life.

Born in 1929, Ehlers studied both mathematics and physics in Hamburg in the 1950s, and he finally chose physics because he could study general relativity with Pascual Jordan, one of the pioneers of quantum physics. At this time, interest in general relativity among theoretical physicists was beginning to revive after decades of neglect. Jordan was one of a handful of senior figures around the world who felt it was time to begin to understand general relativity, in order ultimately to generalize it into a full quantum theory of gravity. Key goals were to understand gravitational waves and what we now call black holes, and Jordan and his school, including Ehlers, were among the pioneers in this revival.

After visiting positions at several universities in Germany and the United States, culminating in a professorship in 1967 at the University of Texas at Austin, Ehlers moved to Munich to become a Member of the Max Planck Institute for Physics and Astrophysics in 1971. Institute director Ludwig Biermann asked Ehlers to join the Astrophysics part of the institute, because the institute was just beginning the gravitational wave activities that would eventually lead to Germany's GEO600 detector. In 1978 Ehlers organized the Ninth Texas Symposium on Relativistic Astrophysics, the principal international meeting where relativists and astrophysicists meet and update one another on their recent research. When the Astrophysics part of the Max Planck Institute moved into a new building in Garching outside Munich in 1979, Ehlers and his group, as well as the gravitational wave experimenters, went with it. Ehlers' clear commitment to astrophysics reflected his clear belief that the most important questions in general relativity were those that would be tested by astronomical observations.

Ehlers nevertheless remained a deeply mathematical physicist, and he always insisted that the great physical and astrophysical questions about relativity theory should be answered with as much rigour and care as possible. But always the important questions for him were those that the Universe itself posed. The discovery in 1974 of the first pulsar in a binary system, by Russell Hulse and Joseph Taylor, was a watershed for relativity, because it was immediately clear that the system would provide the first clean observational test of gravitational wave theory: the two stars would gradually spiral closer to one another as gravitational waves carried energy away. Ehlers quickly grasped how important this result would be, and just as quickly pointed out that the state of the theory of gravitational radiation itself was by no means satisfactory; relativity could not properly be tested against the observations until relativists sorted out the theory.

For the next ten years, Ehlers pushed his own research associates and scientists around the world to do this, with considerable success. The award of the 1993 Nobel Prize to

Hulse and Taylor, the building of giant gravitational wave detectors around the world since the 1990s, and the use of modern supercomputers to predict gravitational wave emission from neutron stars and black holes all rest on secure theoretical foundations, thanks in part to Ehlers' insistence that even the complex mathematics of general relativity should be done carefully and rigourously.

Always looking ahead for the big challenges, Ehlers in the late 1980s took up research into another of Einstein's predictions, the bending of light by gravity. Again he was motivated by recent astronomical discoveries of gravitational lensing, where telescopes see multiple images of the same object, created as light takes multiple paths to the Earth through the gravitational field of an intervening galaxy. But again the theory needed work, and Ehlers stimulated young scientists in Garching to do it better. Today gravitational lensing is a central tool in astronomy, used among other things to prove that the Universe contains far more dark matter than it does stars and visible galaxies. The nature of this dark matter is not known, but it certainly is not composed of the protons, electrons, and neutrons that dominate the world we experience. Ehlers' young associates have gone on to make important and leading contributions to this branch of astronomy.

Ehlers' work at the junction between mathematics and physics had strong influences on the development of mathematics as well. He initiated a number of new research directions in analysis and differential geometry. Notable among these was his theory of reference systems, called "frame-theory". This provides a crucial mathematical link between concepts from classical physics and the geometric language of general relativity, and it has been successfully used to understand the precise relations between the different ways that Newton´s and Einstein´s theories of gravity would describe the same physical system. This is a key question, because many of the tests of the correctness of general relativity rely on measuring some of the small ways in which motions in the Solar System differ from those expected on the basis of Newton's theory of gravity. Ehlers had a rare ability to formulate fundamental physical questions in a precise mathematical language. His influence on research on the mathematics of Einstein's equations will be felt for many years to come.

In 1990 Ehlers had what he later described as the one good political idea in his life: he proposed that the Max Planck Society should create a research institute dedicated to research on gravitation. The reunification of Germany had created a need to expand the Max Planck system into former East Germany, and Ehlers felt that an institute in Potsdam, near Berlin, would not only make sense scientifically but would also finally allow Germany to make a visible and practical repudiation of the Nazis' personal vilification of Einstein, which had driven Einstein away from Berlin and Germany and had completely stopped relativity research in Germany. He used his scientific prestige to open political doors, and the result was the opening in 1995 of the AEI in Potsdam.

His vision for the research scope of the AEI showed again his perceptiveness and interest in relativity as a whole, even in work that was far from his own research. He wanted all of relativity under one roof: astrophysical research into black holes and gravitational waves, mathematical research to keep providing rigourous answers to questions raised by astronomical discoveries, and research designed to lead finally to a quantum theory of gravity, the goal that had motivated the revival of relativity in the 1950s and which even today is still not met. Today the AEI actually has two roofs: its theory branch in Potsdam/Golm, and its experimental branch in Hannover, which operates the GEO600 gravitational wave detector and plays a key role in the development of future detectors on the ground and in space. Employing two hundred staff, hosting a further two hundred scientific visitors each year, housing some of the world's fastest supercomputers, operating the GEO600 detector, hosting numerous conferences and workshops, publishing its own scientific journal and editing others, the AEI amply justifies Ehlers' initial vision that relativity best makes progress by keeping all its sub-fields connected and in communication.

In recent years Ehlers spent more time pursuing his life-long interests in the history of science and the meaning and importance of science to society. He engaged in public debates and wrote numerous articles. He strongly believed that rational thought and the scientific process were key ingredients of a civilised society, but he wanted society to understand the process as a human one, as an ongoing search for an ever deeper reality rather than as a way of manufacturing "laws" written in stone.

Naturally, Jürgen Ehlers won many honours in his lifetime: the Max Planck Medal from the German Physical Society in 2002, the Volta Gold Medal of Pavia University in the "Einstein Year" 2005, and recently the Chancellor's Medal of Charles University in Prague (2007). He was a member of Berlin-Brandenburg Academy of Sciences, the Mainz Academy Academy of Sciences and Literature, the Leopoldina, and the Bavarian Academy of Sciences. In 1995 his scientific colleagues elected him President of the International Society for General Relativity and Gravitation for three years. But despite these honours and his considerable influence, Ehlers will be remembered by those who knew him as a modest man and a gentleman, a mentor who led by his example and by his deep scientific insight, a leader who always showed respect for his colleagues and co-workers.

Jürgen Ehlers will be deeply missed by his scientific colleagues, and of course incomparably more by the family he left behind: his wife Anita, his children Martin, Kathrin, David and Max, and five grandchildren.

The directors of the Albert Einstein Institute