

OBITUARIES

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Karl-Heinz Rieder

Physicist and surface scientist Karl-Heinz Rieder, referred to by colleagues as the “quiet pioneer,” died in Zürich, Switzerland, on 7 March 2017 following a prolonged illness.

Born on 1 September 1942 in Eisenstadt, Austria, Karl-Heinz studied physics and mathematics at the University of Vienna. During his studies, in 1965 he was able to attend the Lindau Nobel Laureate Meeting, an annual gathering in Germany that brings together about 30 Nobelists and hundreds of young scientists. He met such luminaries as Otto Hahn, Paul Dirac, and Werner Heisenberg, who greatly influenced his career.

In 1968 Karl-Heinz obtained his doctorate at the Seibersdorf Laboratories in Austria. His thesis was on inelastic neutron scattering of microscopic crystallites, a subject he continued working on after he took a position at the Max Planck Institute for Solid State Research in Stuttgart, Germany. In 1975 he moved to the IBM Research Laboratory in Rüschlikon, Switzerland. There he and Thomas Engel developed helium scattering as a method to study surfaces. Ten years later he went to the Free University of Berlin, where he initially continued to work on elastic and inelastic helium scattering and on high-resolution electron energy-loss spectroscopy.

Subsequently, Karl-Heinz became active in low-temperature scanning tunneling microscopy; his research group was the second, after the IBM Almaden group, to manipulate individual atoms, molecules, and surfaces. He retired in 2005 yet continued to work at the Swiss Federal Laboratories for Materials Science and Technology in Dübendorf and at the Fritz Haber Institute in Berlin.

Karl-Heinz's accomplishments cover a broad range of surface science. As a result of his work, helium scattering and helium-atom microscopy have become established methods for studying surfaces down to atomic resolution. Early in his tenure at IBM, he realized the impact of the scanning tunneling microscopy technique that his colleagues Gerd Binnig and Heinrich Rohrer were develop-



Karl-Heinz Rieder

ing in the late 1970s. He loaned them his single-crystal samples for the initial measurements, and he sometimes received them back as molten lumps of metal.

Karl-Heinz might be most renowned for his later work developing methods for targeted manipulation of individual atoms and molecules at surfaces. His measurements offered insight into the fundamental physics of place-exchange processes, the associated forces, and excitation by transient attachment of electrons. In a particularly noteworthy achievement, he and his group used a scanning tunneling microscope as a nanoscale manipulator to conduct the chemical synthesis of an organic species one molecule at a time by forming a covalent bond between two surface-attached phenyl radicals. In the 1990s they studied graphene nanoribbons.

In addition, Karl-Heinz is remembered for his appreciation of the arts. For instance, a humorous poem he wrote about the surface-science community was included in the special issue of *Journal of Physics* published in his honor for his 70th birthday. A clarinet and saxophone player, he was part of several ensembles. For a while, he also focused on painting.

Karl-Heinz had a unique combination of scientific curiosity, brilliance in

predicting experimental results, open-heartedness, and supportiveness—always seasoned with kind humor. Those attributes enabled his research group to prosper and its members to feel appreciated and ready to tackle grand challenges. Despite his success, Karl-Heinz remained humble. His coworkers treasure the time they spent in his research group; some 20 of them are now faculty members at various research universities in Germany, the US, Austria, Switzerland, and elsewhere. The guidance Karl-Heinz gave and the example he was to them has made them better group leaders. He has achieved a lasting impact on the surface-science community in particular. He is missed most for his kindness and generosity.

Ludwig Bartels

University of California, Riverside

Saw-Wai Hla

Argonne National Laboratory

Lemont, Illinois

Ohio University

Athens

Joseph Manson

Clemson University

Clemson, South Carolina

Alexis Baratoff

University of Basel

Basel, Switzerland

Leonhard Grill

University of Graz

Graz, Austria

Karl-Heinz Ernst

University of Zürich

Zürich, Switzerland



Sheldon Schultz

Sheldon “Shelly” Schultz, a professor in the physics department at the University of California, San Diego (UCSD), who received worldwide recognition for his contributions to the discovery of metamaterials, passed away at home on 31 January 2017 from complications due to Parkinson's disease.

Born in New York City on 21 January 1933, Shelly received his undergraduate degree in mechanical engineering in 1954 from Stevens Institute of Technology. He earned his PhD in physics in 1960 from Columbia University, where he worked under the supervision of Nobel laureate Polykarp Kusch. That

year he joined UCSD as a founding member of the physics department. He was part of the UCSD faculty until 2016, and he served as the director of the university's Center for Magnetic Recording Research (CMRR) from 1990 to 2000. In addition, Shelly cofounded and was president of Seashell Technology LLC, which has made several important contributions to nanotechnology, nanomaterials, and functional coatings.

Shelly received many academic honors and awards, including an Alfred P. Sloan Research Fellowship in 1964. In 2003 CMRR endowed a graduate student annual prize named in Shelly's honor. His codiscovery of metamaterials was hailed by *Science* as one of the top 10 breakthroughs of 2003. In 2009 Thomson Reuters added Shelly to its list of potential future recipients of the Nobel Prize in Physics for the revolutionary discovery.

With his team at UCSD, Shelly in 2000 first reported the discovery of a "left-handed" or negative-refractive-index material, with which the researchers created a new class of artificially structured materials known as metamaterials. That breakthrough and the lab's first experimental demonstration of negative refraction led to an explosion of interest in the physics and application of metamaterials. The two papers detailing those foundational experiments are pillars of the metamaterials field. They initially generated considerable skepticism and controversy in the physics community, which prompted Shelly to become one of the staunchest and most eloquent defenders of the field. His dedicated efforts greatly publicized the discovery and contributed to the eventual widespread acceptance of negative refraction and metamaterials. The first publication was selected as one of only four *PRL* Milestones in 2000 by *Physical Review Letters*, and both papers have been cited thousands of times.

Shelly's research interests were broad. His most salient contributions include designing, fabricating, and range-testing highly efficient subwavelength antennas operating at 1–2 GHz; using plasmon resonant particles (PRPs) as optical transducers for biochemical and clinical medical applications; and developing PRP-based Kerr scanning near-field optical microscopy. Additionally, he used magnetic field-modulated microwave spectroscopy for sensitive detec-



Sheldon Schultz

tion of high-temperature superconductivity; applied conduction electron spin resonance (CESR) to probe the nature of dilute local moments, spin glasses, and superconductors; and measured Landau Fermi-liquid parameters by transmission electron spin resonance, a variant of CESR of which Shelly was particularly fond.

Shelly was an animated and inspirational lecturer, no doubt due to his lifelong penchant for showmanship (of the best kind) and his flair for the dramatic. He especially enjoyed the excitement and drama of science; he infused his lectures and talks with puzzles and demonstrations that would quickly grab the attention of his audience. Hundreds of UCSD undergraduates had the remarkable fortune of taking Shelly's freshman physics course, which showed off his delight in experimental demonstrations and his not-so-well-hidden joy in revealing the beauty of physics to young minds.

Especially noteworthy was the way Shelly celebrated the PhD defenses of his students. He and his wife, Carol, would hold PhD party "roasts" at their home, complete with a mock ceremony and a "final exam" in which the PhD student had to solve several of Shelly's physics-related brain teasers in order to "pass." A few students even managed to turn the tables on Shelly and effectively roast him in return.

During his long academic career, Shelly supervised and mentored numer-

ous doctoral students and postdoctoral scholars. He cared deeply about the members of his research group, and his enthusiasm, leadership, and high standards brought out the best in them. He taught his doctoral students how to think physically and estimate on the spot. Within reason, they were expected to learn how to conceive, design, build, and repair experimental apparatus. Many of his PhD students have gone on to exceptional careers in research and teaching.

Shelly Schultz was an extraordinary individual, a superb scientist, and a loyal and reliable friend. He had a warm personality, a keen sense of humor, and seemingly boundless energy. He will be greatly missed.

M. Brian Maple

David C. Vier

University of California, San Diego

David R. Smith

Duke University

Durham, North Carolina

Donald M. Eigler

Wetnose Institute for

Advanced Pelagic Studies 

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Dietmar Maximilian Schoeffel

8 July 1931 – 16 September 2017

Stewart D. Bloom

22 August 1923 – 5 August 2017

Paul H. E. Meijer

14 November 1921 – 9 July 2017

Joseph Andrew Johnson III

26 May 1940 – 25 June 2017

Robert J. Hardy

26 January 1935 – 20 June 2017

Van E. Wood

25 May 1933 – 19 May 2017

Arthur H. Muir Jr

26 August 1931 – 12 April 2017

Ernest Henley

10 June 1924 – 27 March 2017

Peter H. Rose

30 November 1924 – 23 March 2017

Haim Goldberg

30 November 1938 – 5 February 2017

William E. Drummond

18 September 1927 – 14 December 2016

Michael Alan Jura

11 September 1947 – 31 January 2016

Richard A. Webb

10 September 1946 – 23 January 2016