

research in the 1960s and 1970s was an important component of the NBS atomic data program, which was expanded during those years to include atomic energy levels, transition probabilities, and oscillator strengths. Klose's measurement of the lifetime of the 372-nanometer resonance line in neutral iron was published in the *Astrophysical Journal* in 1971. It remains one of the best values, used through the years to put relative measurements of transition probabilities in iron on an absolute scale.

In the 1980s, Klose helped to develop primary and secondary standard radiation sources in the vacuum UV region of the spectrum and used those standards to calibrate sources for projects such as the Solar Ultraviolet Spectral Irradiance Monitor and the *Hubble Space Telescope*. In 1987, he received the US Department of Commerce's Bronze Medal Award for that work.

He retired from NBS the following year—just before the transition to NIST—but continued with his research at NIST until the late 1990s. During that period, he published a series of papers on applications of the branching ratio technique for making absolute vacuum UV radiation measurements.

Jules, as everyone called him, was a World War II veteran, who served with the US Army in Japan. He had a lifelong interest in tennis and was a founding member of the Anne Arundel County Tennis Association in Maryland, for which he served as president in 1971. He was a member of the NBS tennis team for 25 years and competed—in the number one position for many of those years—in the federal interdepartmental tennis league in Washington, DC. He had a great interest in the history of American railroads and was a member of the Maryland and Pennsylvania Railroad Preservation Society. He also was an active parishioner of St. Mary's Church in Annapolis for 50 years.

William R. Ott

NIST

Gaithersburg, Maryland

Ralph Marks Moon Jr

Ralph Marks Moon Jr, a world leader in the use of neutron-scattering techniques to investigate the properties of materials, died of cancer on 1 June 2004 at his home in Oak Ridge, Tennessee.

Ralph was born in Bombay, India, on 11 October 1929. His family returned to the US in 1931 and settled in Kansas City, Missouri, where

Ralph received his early education in the public schools. He attended the University of Kansas in Lawrence and earned his BA (1950) and MA (1952), both in physics.

Ralph subsequently spent two years at the US Naval Ordnance Test Station in China Lake, California, doing research on the physical properties of rocket propellants. He left that position in 1954 to enter military service and served three years in the US Navy as a guided-missile officer. In 1958, he entered graduate school at MIT, where he also worked as a staff associate at the Lincoln Laboratory. He carried out his thesis research, which involved using neutron scattering to determine the magnetic-moment distribution in hexagonal cobalt, under the direction of Clifford Shull, who would later receive the Nobel Prize in Physics (see Shull's obituary in *PHYSICS TODAY*, October 2001, page 86). Ralph earned his PhD in physics from MIT in 1963. He joined the staff of the Oak Ridge National Laboratory (ORNL) in 1963.

From the beginning of his career, Ralph was an outstanding scientist who maintained exceptionally high standards in the quality of his work. He did not like to do anything superficially; he wanted to understand a problem completely, plan the best course of action, and carry it to a successful conclusion. Although primarily an experimentalist, he had a very good understanding of solid-state theory, and his combination of skills produced excellent research.

Most of Ralph's scientific contributions involved the applications of neutron-scattering techniques to magnetic materials, and his work added to the overall understanding of

magnetism. His precise measurements, by polarized neutron scattering, of magnetic form factors established a new standard for that type of research and provided valuable information on the outer atomic electrons responsible for interesting chemical and physical properties of materials.

Ralph's research was driven by his interest in discovering new techniques. His most important and ingenious work was the development, in 1969, of the neutron-polarization analysis technique, in collaboration with Tormod Riste, a visiting scientist from Kjeller, Norway, and Wallace Koehler of ORNL. This technique permits the accurate separation of magnetic scattering from nuclear scattering, and it is used in neutron centers worldwide to study many different classes of materials.

Some of Ralph's most important contributions to science, however, came from management responsibilities that he was willing to accept. He became head of the neutron scattering program in ORNL's solid-state division (now the condensed matter sciences division) in 1985, acting division director in 1992, and associate division director in 1993. Under his leadership, scientists from other organizations and ORNL established several collaborative programs in neutron scattering. One of the most significant, involving a collaboration between scientists from the US and Japan, was initiated under the US-Japan Agreement on Cooperation in Research and Development in Science and Technology that was signed in 1980. The neutron scattering program began in 1981 and continues today as a highly successful model for international research cooperation. After his retirement in 1994, Ralph continued to work at ORNL as a consultant and helped with upgrades of research instruments at the High Flux Isotope Reactor.

Ralph made widely recognized contributions to the scientific community as a leader on several important national committees, panels, and workshops. Many of those activities were associated with his interest in and hard work promoting a new high-intensity neutron source for the US. That effort, begun in the 1970s, laid the foundation for the approval of the Spallation Neutron Source now under construction at ORNL.

In addition to his extraordinary technical competence, Ralph possessed an unusual combination of integrity, honesty, and talent for calm analysis that earned him respect and admiration among his peers. He was



Ralph Marks Moon Jr

an exceptionally nice person, and he had many friends in universities and research centers throughout the world. All of his friends miss him very much.

Michael K. Wilkinson

Oak Ridge, Tennessee

Herbert A. Mook Jr

Oak Ridge National Laboratory

Oak Ridge, Tennessee

Gerald James Small

Gerald James Small, a leading physical chemist and pioneer in spectroscopy and photosynthesis, died in Ames, Iowa, on 7 August 2004 after a courageous battle with lung cancer.

Gerry was born on 18 January 1941 in Vancouver, British Columbia. He earned a BSc in chemistry and mathematics in 1963 from the University of British Columbia and a PhD in chemistry in 1967 from the University of Pennsylvania, where he was the first student of one of us (Hochstrasser).

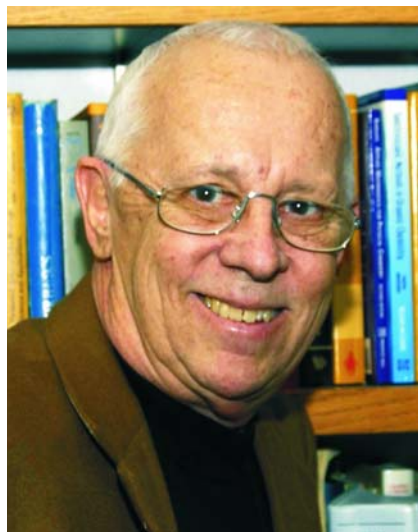
Following a postdoctoral fellowship in 1969 with David P. Craig at the Australian National University in Canberra, Gerry joined the chemistry department of Iowa State University in Ames. He became a distinguished professor of liberal arts and sciences and spent his academic career at Iowa State.

By following the quantitative physical chemistry approach and insisting on the highest standards, Gerry orchestrated important discoveries in chemical physics, biophysics, and medical diagnostics, and has had a lasting impact on these fields. Yet, he was a genuinely modest person who did not hyperbolize his contributions. In fact, he was the first to point out the essential roles of his collaborators and other investigators.

In his earliest work, Gerry focused on low-temperature spectra of mixed molecular crystals. He explained the mysterious occurrence of multiplets in the optical spectra of aromatic hydrocarbons in frozen solids and quantitatively explained them by simulating the structure distributions of impurity molecules in crystals. In the 1970s, he explored new spectroscopic approaches to examining phonon relaxation in molecular aggregates. That effort led to his developing the basic model of fluctuating two-level systems to explain spectra of amorphous molecular solids and glasses. He provided fundamental insights into the dynamics of strongly coupled excitons and photons in molecular crystals and imparted essential

knowledge of coupling, coherence, and intermolecular forces in aggregates and organic nanostructures.

In 1978, Gerry introduced the method of nonphotochemical hole-burning, in which line-narrowed absorption spectra of inhomogeneously broadened bands are obtained without photochemical destruction of the material. That method led to his discoveries in organic and biological materials. His approach allowed him to unravel the detail behind broadband molecular spectra and yielded new knowledge of dispersive kinetics, dephasing mechanisms, and relaxation processes. His unbounded enthusiasm for his science then led him to use line-narrowing spectroscopic techniques to expand an understanding of photosynthesis.



Gerald James Small

His first major success in photosynthesis came in 1986, when he and Iowa State colleague John Hayes reported line-narrowed spectra of the primary electron donor of photosynthetic bacteria, a special pair of chlorophylls involved in the initial act of photochemical charge separation. At that time, some thought the separation occurred in 20 femtoseconds. However, Gerry proved that this fast relaxation of the special pair is due to strong electron-phonon coupling and not to the electron transfer that occurs in about 1 picosecond. His findings explained the transients seen in ultrafast laser experiments. Measurements capable of providing information in that very fast time scale were brought into agreement with each other primarily because of Gerry's efforts.

Gerry used similar methods to determine the Franck-Condon factors associated with the spectral density of

the rate coefficient for energy transfer in the light-harvesting molecules that mediate photosynthesis. He also quantified the static energy disorder of proteins and characterized the exciton bands of the light harvesters of purple bacteria. He noticed that his results could be explained by assuming cyclic symmetry for those complexes. The high-resolution x-ray structures and quantum chemical calculations that followed supported his benchmark interpretation.

Gerry also measured the correlations of how the complexes' excited state energies were distributed, and, in work in 1992 with Bob Silbey of MIT, he defined the conditions for the complexes' dispersive kinetics. By combining hole-burning and Stark effects, he identified the presence of exchange coupling in photosystem I of green plants, cyanobacteria, and photosystem II, a protein-pigment complex involved in oxygen production in algae and higher plants. The techniques and views he championed are now essential to those investigating the photosynthetic process.

In 1984, in work that advanced analytical methods for diagnosis, Gerry and Alan Jeffrey of the Cancer Institute (now the Institute for Cancer Genetics) at Columbia University used fluorescence line narrowing to characterize the structures of DNA carcinogen adducts. As Gerry showed in his 2002 work with Lynn Hartmann of the Mayo Clinic, that method distinguishes normal and carcinoma ovarian surface epithelial cells. In 2004, Gerry and Ryszard Jankowiak of Iowa State developed a line-narrowing method involving monoclonal antibody (gold biosensor chip that detects DNA carcinogen interactions at the level of one adduct in 108 base pairs). For his numerous analytical discoveries, Gerry won a Research and Development 100 Award from the US Department of Energy in 1998.

Gerry was exceptionally kind and considerate, liked by everyone who knew him. His great number of close friends and colleagues from across the world miss him and think of him often.

Robin M. Hochstrasser

University of Pennsylvania

Philadelphia

James R. Norris

University of Chicago

Chicago, Illinois

Shaul Mukamel

University of California, Irvine ■