

develop new numerical methods. With William C. Reynolds, he pioneered the large-eddy simulation method, which made computation of turbulent flows at large Reynolds numbers possible. Much of Joel's research focused on developing the theoretical underpinnings and the subgrid-scale closure models so critical to the success of that approach. His work in 1983 with Reynolds and Jorge Bardina led to a new approach to the modeling of subgrid-scale motions; their scale-similarity model underpins most of the modern closure models. In addition, Joel's work contributed greatly to advances in aircraft engine design and combustion.

Joel received numerous honors during his career, including a Humboldt Research Award from the Alexander von Humboldt Foundation in 1987 and the 1991 Max Planck Research Prize, which was presented by the Humboldt Foundation and the Max Planck Society.

Joel wrote more than 100 archival journal articles and several textbooks, including *Computational Methods for Fluid Dynamics* with Milovan Perić (Springer, 1996). The first (1981) and second (1998) editions of his *Numerical Methods for Engineering Application* (Wiley) are likely to be found on the desks or bookshelves of many engineering faculty and students. Joel's course on numerical methods at Stanford was very popular, not only for mechanical engineering students but also for those in other engineering disciplines.

In addition to his contributions to engineering, Joel was known for his passion for gourmet cooking and wines. He put those interests to use during the frequent gatherings he hosted for his students, family, and friends. He loved to explore other countries, but often returned to his apartment in Paris. He was devoted to his wife, Eva, his daughters, and his beloved grandchildren.

When Joel gave us copies of his books, he often inscribed them with words such as, "To a great friend and colleague." Back at you, Joel!

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John Seth Laughlin

John Seth Laughlin, world-renowned medical physicist and leader in the application of radiation for cancer diagnosis and therapy, died from complications of acute myelogenous leukemia on 11 December 2004 in New York City.



John Seth Laughlin

Laughlin was born in Canton, Missouri, on 26 January 1918. He received an AB from Willamette University in Salem, Oregon, in 1940 and an MS from Haverford College in Pennsylvania two years later. He received his PhD in 1947 from the University of Illinois, where he studied with Donald Kerst, inventor of the betatron. He subsequently joined the faculty of radiology as an assistant professor. Together with scientists in Kerst's lab, Laughlin developed the betatron's first medical applications for cancer treatment.

In 1952 the New York City-based Memorial Hospital (later the Memorial Sloan-Kettering Cancer Center) recruited Laughlin as its new chairman of the department of medical physics. He served in that post until his retirement in 1989. He conducted seminal work on the use of electrons from betatrons for the treatment of cancer and led original research in calorimetry, radiation dosimetry, and radiation protection. The original betatron at Memorial was transferred to the Smithsonian Institution in 1977.

Laughlin became chief of Memorial's laboratory of biophysics in 1955; he remained in that post until his retirement. In 1966 he was one of the first investigators to install a cyclotron in a medical research center to produce short-lived radionuclides; that process

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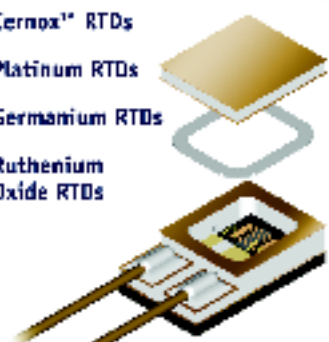
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was the predecessor of positron emission tomography scanning, which is used today in nuclear medicine.

Laughlin was vice president of the cancer center from 1966 to 1972 and, from 1980 until his retirement, was a professor of radiology at Cornell University Medical College. He was an emeritus member of the Sloan-Kettering center. During his career, he published more than 200 papers on biophysics and medical physics topics.

An active participant in a number of organizations, Laughlin was a founder and president, from 1964 to 1965, of the American Association of Physicists in Medicine (AAPM). He also led several societies: the Health Physics Society (1960–61), International Organization of Medical Physics (1969–72), and Radiation Research Society (1970–71). He chaired the Medical Advisory Committee of the New York City Department of Health from 1960 through 1978 and, in 1992, was vice president of the Radiological Society of North America. Laughlin was the editor-in-chief of *Medical Physics* (1988–96), a consultant to the Atomic Bomb Casualty Commission and Los Alamos National Laboratory, and a fellow of many organizations.

Among his many honors were AAPM's William D. Coolidge Award (1974), the Distinguished Scientific Achievement Award of the Health Physics Society (1982), the Aebersold Award of the Society of Nuclear Medicine (1984), the Gold Medal of the American College of Radiology (1988), the Marvin M. D. Williams Professional Achievement Award of the American College of Medical Physics (1992), and the Gold Medal of the American Society for Therapeutic Radiology and Oncology (1993).

Laughlin was very proud of his Scottish heritage and was known for appearing at parties dressed in a red tartan vest. He was an inveterate music lover: He and his wife, Eunice, enjoyed the Wednesday evening subscription series at the Metropolitan Opera and subscribed to the Rockefeller University concert series. He loved to coax unwary visitors into playing squash and wicked croquet games in his backyard.

**Jean St. Germain
C. Clifton Ling**

*Memorial Sloan-Kettering Cancer Center
New York City*

Hans Pauly

Hans Pauly, a highly respected, internationally known leader in the development of molecular-beam scattering studies of intermolecular forces,

died of a heart attack on 13 March 2004 at his home in Göttingen, Germany. He had been a founding director of the Max Planck Institut für Strömungsforschung (Max Planck Institute for Fluid Dynamics; renamed the Max Planck Institute for Dynamics and Self-Organization in 2004) in Göttingen and was instrumental in transforming that institute into a world-class center for molecular-beam research.

Born in Bonn on 12 November 1928, Pauly grew up in Cologne and Bonn. He entered the University of Bonn in 1949, a few years after its reopening following World War II. He devoted his *diplom* project, which he carried out under the direction of Wolfgang Paul, the newly appointed professor of experimental physics who would later share the 1989 Nobel Prize in Physics, to the construction of a special ion source for the just-developed quadrupole mass filter. Subsequently, he was fascinated by the vision of Paul's colleague, Rudolf Jaekel, who wanted to explore atomic collision processes in vacuum diffusion pumps to improve the pumps' performance.

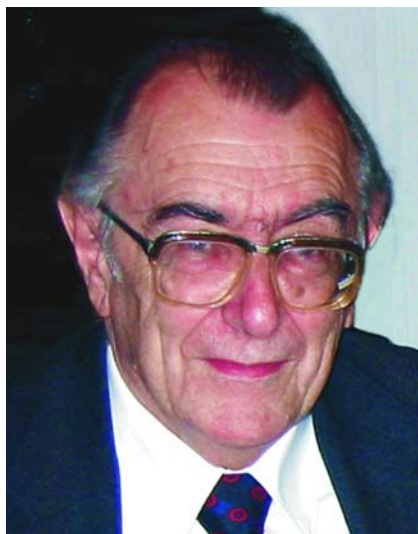
Working largely independently, Pauly realized the basic importance of intermolecular potentials. To investigate them properly, he constructed in 1955 the first prototype of a modern molecular-beam apparatus, which in itself was a remarkable accomplishment considering the still-adverse postwar conditions. His successful measurements of the velocity dependence of integral atom–atom scattering cross sections confirmed the $v^{-2/5}$ law predicted by H. S. W. Massey and C. B. O. Mohr in 1933. Pauly's findings thereby provided the first direct experimental confirmation of the R^{-6} radial dependence of the fundamen-

tally important long-range attractive potential predicted in the 1930s by Fritz London and others. In his 1958 doctoral dissertation, entitled "Streuerersuche an Molekularstrahlen" ("Molecular Beam Scattering Experiments"), Pauly developed and anticipated many aspects of modern quantum mechanical approximations for calculating atomic collision cross sections.

His research and the parallel independent molecular-beam experiments on chemical reactions in the US, triggered by the breakthrough experiment of Ellison Taylor and Sheldon Datz in 1955, were responsible for the ensuing rapid developments in molecular-beam scattering experiments in the early 1960s. His work also stimulated the research of US scientists Richard Bernstein, Datz, Ned Greene and his colleague John Ross, Dudley Herschbach, and Erhard Rothe and colleagues and inspired related studies in Europe largely by the German groups of Dieter Beck, Otto Osberg-haus and Christof Schlier in Freiburg, and Hans-Gerhard Bennewitz and one of us (Toennies) in Bonn. It was the spectacular successes of those groups that ultimately convinced the Max Planck Society to reorganize the MPI Strömungsforschung in 1969 to make molecular-beam scattering research a central part of that institute.

In the newly reorganized institute, Pauly and his colleagues continued their precise measurements of scattering cross sections. They systematically investigated elastic integral and small-angle differential cross sections and resolved glory undulations and identical particle oscillations and resonances, first for alkali atom projectiles and then for nonalkali systems with all kinds of targets. To extend the collision energy range to more than 1000 eV, an effective charge-exchange source was developed. Similar experiments were carried out for measuring large-angle differential cross sections and completely resolved the supernumerary rainbow oscillations with superimposed, closely spaced interference oscillations. Through a newly developed, highly efficient scheme, the measured cross sections could be inverted to obtain precise experimental potential curves for the first time.

Those and related experiments stimulated calculations by quantum chemists throughout the world. Subsequent investigations at the institute were devoted to understanding the interactions of electronically excited atoms, either short lived (laser excitation) or long lived (metastables). Careful execution and extraordinary precision coupled with elegant theoretical



Hans Pauly