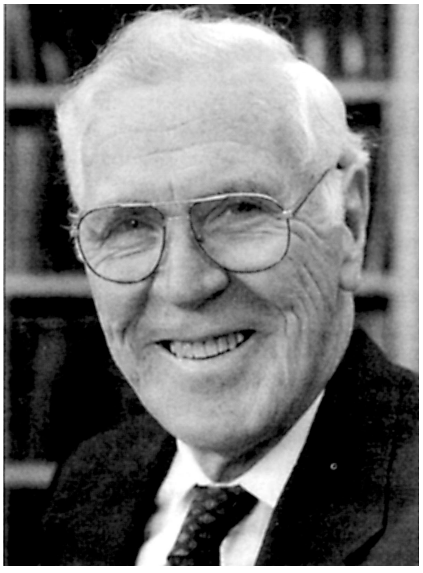


Charles Kincaid Bockelman

After receiving his doctorate, Bockelman went to MIT and worked for four years with W. W. Buechner, studying neutron interactions at higher energies with an emphasis on high-resolution analyses of the reaction products. Bockelman's work on the resonant scattering of protons and deuterons due to energy levels in odd–odd compound nuclei provided both early information on charge independence in nuclear reactions and measures of isotopic spin impurities in those states.

In 1955, Bockelman went to Yale, where, with Howard Schultz, he investigated neutron capture resonances and continued some of the nuclear spectroscopy studies he had initiated at MIT. During the early 1960s, he and Schultz worked on the preparation of facilities for the 70-MeV electron accelerator they obtained in 1964. Bockelman then used that accelerator to study nuclear structure through inelastic electron scattering. Later, with one of us (Bromley), he helped develop a large multigap magnetic spectrometer to be used at the new Arthur W. Wright Nuclear Structure Laboratory at Yale. Over the next decade, Bockelman used this instrument to study the properties of heavy- and medium-mass nuclei.

The graduate students who worked on those programs with him included Dennis Kovar, who currently is responsible for all of nuclear and much of particle physics in the US Department of Energy's Office of Science; Robert Eisenstein, who, until recently, was NSF's assistant director for mathematical and physical sciences (see page 74 in this issue); Lawrence Cardman, director of research at the Thomas Jefferson National Accelerator Facility; and Peter Barnes, former director of the Los Alamos National Laboratory Meson Physics Facility. All of them show clear evidence of Bockelman's training and of his integrity, honesty, and love of physics.

Bockelman's research career of 20 years, though, was slowed by demands for his administrative abilities by those who admired his wisdom, intelligence in human affairs, responsible manner, and good sense. He was asked to take on the position of director of the physical sciences at Yale in 1966. Three years later, he took the newly created position of deputy provost for science, which he held for two decades. In those capacities, he facilitated the construction of new buildings, the implementation of computer systems, the setting up of new faculty, the maintenance of senior faculty programs, and the growth of the sciences. He also spent interregnum periods as acting provost and as acting dean of the graduate school.

Bockelman made significant contributions to physics research, to the education of students in the classroom and laboratories, and, in his administrative capacity, to research in all sciences at Yale. Perhaps his most fitting epitaph, however, is found in a remark by a young administrator in the Yale physics department: "He was such a nice man!"

**Robert K. Adair**
**D. Allan Bromley**
*Yale University*
*New Haven, Connecticut*

## Bunji Sakita

Bunji Sakita, whose research helped form the foundation of string theory and who made seminal contributions to the quark model, died on 31 August 2002 in Tokyo after a yearlong battle with cancer.

Sakita was born in the Toyama prefecture of Japan in 1930. He attended Kanazawa University, where he received his bachelor's degree in physics in 1953. He pursued graduate work with Shoichi Sakata's group at Nagoya University, where he earned his master's degree in physics in 1956. He then traveled to the US to study at the University of Rochester; he was among a select group of Japanese students that Robert Marshak had recruited to study at the university. There, under the guidance of Charles Goebel, Sakita received his PhD in physics in 1959.

Bunji Sakita

That same year, he became a research associate in the physics department of the University of Wisconsin–Madison. He was named an assistant professor in 1962 and remained in that position for two years. During those early years of his career, he developed the SU(6) symmetry of the nonrelativistic quark model, which generalized Eugene Wigner's supermultiplet symmetry of combining spin and isospin. Sakita then joined the high-energy physics division of Argonne National Laboratory but returned to Wisconsin in 1966 to take the post of professor of physics.

During a visit to Israel in 1967, Sakita learned of the work of Gabriele Veneziano. Sakita subsequently devoted his later work at Wisconsin to what would become the dual resonance model and, later, string theory. With Goebel, he obtained the many-particle generalization of the Veneziano amplitude. With Keiji Kikkawa, Miguel Virasoro, and others, he addressed the problem of unitarity of the dual amplitudes and set up the formalism of dual diagrams, which were analogous to Feynman diagrams, for the computation of loop amplitudes. Sakita then collaborated with C. S. Hsue, Virasoro, and Jean-Loup Gervais to develop the functional formalism for those calculations in which summation over Riemann surfaces naturally emerged.

In their paper "Field Theory Interpretation of Supergauges in Dual Models," published in *Nuclear Physics* in 1971, Gervais and Sakita described the first supersymmetric action in the framework of world sheet string theory. Their work inspired Julius Wess and Bruno Zumino to extend supersymmetry to four-dimensional field

theory. (A different version of supersymmetry had been developed in the former Soviet Union a little earlier.) Sakita's papers during the 1970–71 period reflect the origins of the modern formulation of string perturbation theory as sums over Riemann surfaces. He also planted the seeds of another key idea of string theory: conformal field theory.

When Marshak became president of the City College of New York in 1970, Sakita took a position there as a distinguished professor so that he could participate in the rapid expansion of the physics program and head the high-energy group. Through Sakita's leadership, the group did first-rate work in string theory, supersymmetry, field theory, and particle phenomenology. Having been greatly influenced since his student days by the method of collective variables in many-body theory, Sakita continued the theme of collective motions throughout the remainder of his career. With his students Gustavo Branco and Paul Senjanovic, he worked on collective dynamics in the strong coupling theory of meson–nucleon physics in the path integral approach. He extended that work, with Gervais, to relativistic field theory with solitons. And in 1975, he and one of us (Jevicki) developed the full perturbation theory and the general formalism of collective coordinates.

Sakita's several other collaborations produced interesting research. With one of us (Wadia, who was his student), together with Gervais, Sakita achieved extensions to gauge theories. During the late 1970s, Sakita and Jevicki applied the collective field method to the large-$N$ limit of matrix models (in which it has become part of the standard lore). Sakita also worked with Jorge Alfaro to apply the method of stochastic quantization to large-$N$ theories. He made significant contributions to condensed matter systems through his work on exhibiting the role of W symmetry.

An exceptional mentor, Sakita treated his students as his equals. He had numerous collaborators and students worldwide. In recognition of his many contributions, he was named a Guggenheim Fellow in 1970 and, in 1974, received the Nishina Memorial Foundation's Nishina Memorial Prize of Japan.

Sakita's interests were broad and varied; he sought out the fundamental physical basis of any problem. He had a true measure of himself, both as a person and as a physicist, which translated into a sense of humility and generosity. Sakita also possessed an unobtrusive yet direct way of speaking. His opinion, on matters of physics and nonphysics, was highly valued. He is sorely missed.

**Michio Kaku**
*City College of New York*
*New York City*
**Antal Jevicki**
*Brown University*
*Providence, Rhode Island*
**Spenta R. Wadia**
*Tata Institute of Fundamental Research*
*Mumbai, India*

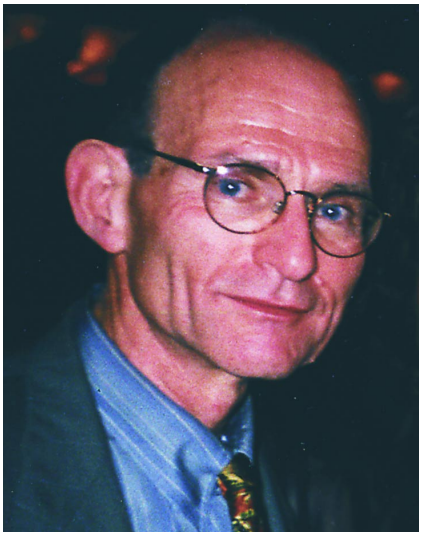
## Bruce Albert Scott

Bruce Albert Scott, a solid-state chemist, technical manager, and program director of technical recruiting at IBM Corp's T. J. Watson Research Center in Yorktown Heights, New York, died on 1 October 2002 in Vineyard Haven, Massachusetts, after a 10-year battle with cancer.

Bruce was born on 23 February 1940 in Trenton, New Jersey. He received a BS in chemistry from Rutgers University in 1962 and earned his PhD in solid-state chemistry from Pennsylvania State University in 1965. His doctoral thesis, under Robert Bernheim, was entitled "NMR and Magnetic Susceptibility Studies of Transition Metal Monophosphides."

After beginning his professional career with a short stint at DuPont's Eastern Laboratory in Gibbstown, New Jersey, where he was involved in the development of catalytic processes for the synthesis of organic polymer intermediates, Bruce joined the T. J. Watson Research Center in 1967. He spent the remainder of his productive and multifaceted career there. In the ensuing years, he made contributions in the areas of solid-state chemistry and structure–property relationships in a variety of systems including metal-oxide systems, metal complexes, amorphous solids, organic metals, and high-temperature superconductors. He also contributed to an understanding of the kinetics and mechanisms that govern thin-film deposition processes.

He became a manager in the physical sciences department in 1972 and championed several new efforts in the study of organic semiconductors and metals, electroactive polymers, chemical-vapor deposition of copper oxide superconductors, nanoscopic materials, and silicon-materials chemistry. His work in silicon-materials chemistry was an important inspiration to further the studies in the science and technology of low-temperature silicon and silicon–germanium epitaxy.



**Bruce Albert Scott**

From the late 1980s to the late 1990s, Bruce's research focused on the synthesis and solid-state chemistry of new superconducting materials at high pressures, which led to a fruitful collaboration with scientists at Columbia University's Lamont–Doherty Earth Observatory. In 1989, Bruce was appointed senior manager of chemistry and materials science in a promotion that recognized his managerial talent.

During the last few years of his life, Bruce committed all his energy to recruiting science students from underrepresented minority groups. Not surprisingly, he carried out this responsibility with his typical intensity and zest. Until his death, Bruce directed the recruitment effort.

Bruce was an accomplished technical manager, an effective recruiter, and an inspiring mentor to many. His contributions have been recognized by his colleagues, both at IBM and in the scientific community at large. He had a natural curiosity about the world around him. He was a closet geologist and an avid jogger who combined the two activities into a hobby by collecting unusual rocks while jogging. In his office, he proudly displayed his rock collection.

A jovial man who cared a great deal about others, Bruce appreciated good humor and often quoted from Bob Dylan songs. I will particularly miss the many lively lunch discussions I had with him while he was eating his staple lunch, cranberry juice-soaked granola. Bruce enriched the lives of many and he is missed by his family and colleagues.

**Nabil M. Amer**
*IBM Corporation*
*Thomas J. Watson Research Center*
*Yorktown Heights, New York*