

at Cold Spring Harbor, but actually spent much time at the physics department of Columbia University, where he started his exploration of the effects of radiation on matter. At Cold Spring Harbor, Ugo studied the biological effects of radiation on living organisms. During his early work with *Drosophila* and genetic resistance to radiation effects, and his later work at the National Bureau of Standards (NBS), he set himself to the task of sorting out the complex array of processes that radiation could induce in living systems.

In 1946, Ugo joined the group of Lauriston Taylor at the NBS, where he elucidated fundamental physical processes. He worked closely with experimentalists such as Robert Madden and Keith Codling to use synchrotron radiation to study spectra in regions previously almost inaccessible, and then, with theorists around him, to interpret those results. One notable example concerned the excitation of quasi-bound states buried in continua, whose spectra, with their Fano line shapes, imply much about the nature of electron correlation.

In 1966, with the NBS's impending move to Gaithersburg, Maryland, Ugo's old friend Robert Platzman and the chair of the University of Chicago physics department, Mark Inghram, persuaded him to join the physics faculty at Chicago. There, Ugo developed a lively group of graduate students and postdoctoral associates, many of whom are now spread throughout academia, government, and industry, continuing research in the tradition they learned from him. Ugo continued, uninterrupted, his research on the interaction of radiation and matter well past his retirement in 1982 and into the late 1990s.

Ugo was always very matter-of-fact, questioning every new scientific hypothesis and model with a candor characteristic of a true scholar. He emphasized the importance of working on problems that appeared solvable in the sense of finding an effective way to connect what one knew with something yet to be found. He was skeptical of efforts to solve "fundamental" or what he considered "philosophical" problems in physics, not because he thought these were unimportant. On the contrary, he thought that current theory could only be a partial, incomplete description of physics. In his humility, he believed that people capable of truly contributing to those problems are so rare that nobody he knew should

bother to try.

Ugo received the Enrico Fermi Award from the US Department of Energy in 1995. The special issue of *Physics Essays* (June and September 2000) honors Ugo. It contains his curriculum vitae, a bibliography, a biographical essay, and 40 articles on recent developments in topics he studied. The issue also carries his last article, "Memories of an Atomic Physicist: For My Children and Grandchildren."

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Minoru Oda

Minoru Oda, the founder of space astronomy in Japan and a key participant in the exploratory work in the US that initiated the field of x-ray astronomy, died in Tokyo on 1 March 2001 from complications following surgery.

Oda was born on 24 February 1923 in Sapporo, Japan, the elder son of a distinguished physician. After earning a BS degree in physics at Osaka Imperial University (now Osaka University) in 1944, he was recruited to the Japan Naval Research Laboratory's Shimada branch, established by Prince Takamatsu in a remote location to shield scientists from the war. Many years later, Oda recounted that microwave research at Shimada achieved a beam strong enough to cook rice or even kill a dog at some distance. More important, many of the Shimada scientists became leaders in the postwar development of science in Japan and around the world.

As a graduate student in 1947, Oda's interest was drawn to the possibilities of radio astronomy by his supervisor, Yuzuru Watase. Oda and Tatsuo Takakura built a 3.3-GHz radio telescope with which they observed solar radio emissions, the first radio astronomy observations in Japan. In 1950, Oda was appointed assistant professor of physics at Osaka City University. Three years later, he came to MIT as a visitor to the cosmic-ray group of Bruno Rossi. Oda helped set up the first of the large extensive cosmic-ray air shower experiments carried out by the Rossi group with their new methods of density sampling and fast timing. Thus began a lifelong friendship between Oda and Rossi, two of the most influential scientists in the development of

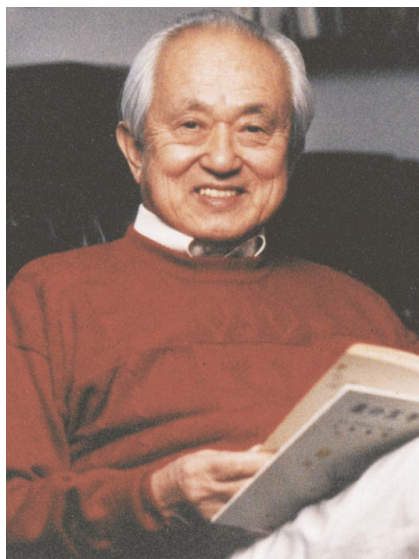
cosmic-ray and space physics.

On his return to Japan in 1956, Oda received his doctorate in physics from Osaka Imperial University. That same year, he was appointed an associate professor of physics at Tokyo University's Institute for Nuclear Studies (INS). At INS, Oda initiated cosmic-ray studies, among which was the Bolivian Air Shower Joint Experiment (BASJE). Inspired by the theoretical work of Satio Hayakawa, the BASJE was designed to detect extensive air showers of low muon content initiated by primary gamma rays produced in interactions of cosmic-ray nuclei with interstellar matter. Koichi Suga came to MIT from INS to build the equipment that was set up at 17 000 feet on Mount Chacaltaya in Bolivia under the direction of Ismael Escobar. The experiment detected showers with the expected low proportions of muons at an occurrence rate consistent with predictions, but did not yield certain evidence of a predominantly gamma-ray origin.

Oda returned to MIT in 1962, intending to work on BASJE data. His interest was diverted by the discovery of the first extrasolar x-ray source, Sco X-1, in a rocket experiment initiated at the urging of Rossi and carried out by Riccardo Giacconi and his associates at American Science & Engineering Inc (AS&E). Recognizing the importance of higher angular resolutions in x-ray observations than could be obtained with conventional collimators, in 1965 Oda invented the modulation collimator, a device of two or more layers of parallel wires and the forerunner of the various transform collimators that have since been used in x-ray and gamma-ray observations where imaging by reflection is not feasible.

In 1966, a joint AS&E-MIT rocket experiment with modulation collimators determined the position of Sco X-1 within a few arc minutes, which enabled scientists to identify the optical counterpart as a rapidly fluctuating 13th-magnitude blue star in observations at the Tokyo and Palomar observatories. The discovery and optical identification of Sco X-1 were the sparks that ignited the field of x-ray astronomy.

That same year, Oda was appointed a professor of physics at the newly formed Institute of Space and Aeronautical Science (ISAS) at Tokyo University. Under his leadership, ISAS launched a series of increasingly sophisticated satellite observatories, several with instruments developed in collaborations with US and European



MINORU ODA

laboratories. In 1984, Oda became ISAS's director general. Among the projects he promoted was VSOP, the VLBI (Very Long Baseline Interferometry) space observatory program. The acronym VSOP (also a type of cognac) suggests the many well-lubricated occasions enjoyed by Oda and his colleagues as one after another of their satellites was launched, on schedule and within budget.

On retirement from ISAS in 1988, Oda was appointed president of the Institute of Physical and Chemical Research (RIKEN), an organization in Wako, Japan, with more than 2000 people in more than 50 research areas, from particle physics to genome science. Oda widened international collaborations, stimulated new programs in high-energy astronomy and brain research and established the RIKEN advisory council, similar to the visiting committees of many US and European institutions but rarely used in Japan. Following a five-year term at RIKEN, Oda became director of the International Institute for Advanced Studies for two years, and president of the Tokyo University of Information Sciences until his death.

As scientist, administrator, and adviser to the Japanese government, Oda was esteemed for his wisdom and fairness, his sure sense of scientific strategy, his ability to marshal the resources for large projects, and his generosity in promoting the careers of his students and associates.

Among Oda's many honors are the Nishina Memorial Prize (1967), the most prestigious physics prize in Japan, given by the Nishina Memorial Foundation; the Japan Academy Award (1975); and Japan's Order of

Cultural Merit (1993). He also was awarded the First Class Order of the Sacred Treasure, presented by the Japanese emperor, and the 1996 COSPAR Space Science Award from the Committee on Space Research (COSPAR) of the International Council for Science.

Away from his duties he was a member of the Mozart Society of Tokyo and the Japan Alpine Club. He and his wife Tomoe often stopped on their travels at a favorite chalet in the Swiss Alps where they would hike, enjoy fine wines, and eat well. She would gather wildflowers of which he would make exquisite drawings and watercolor paintings.

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Harry Brumberger

Harry Brumberger, professor Emeritus of chemistry at Syracuse University and a pioneer in the field of small-angle x-ray scattering, died on 10 November 2000, in a Syracuse hospital, where he had been admitted for implantation of a pacemaker.

Harry was born on 28 August 1926 in Vienna, Austria. As a young teenager, he came to the US with his parents to flee anti-Semitic persecution. He held great affection for pre-1930s Austria, particularly Vienna, and talked often of the city's vibrant cultural and intellectual life. However, he spoke very little of the experiences in Austria that prompted his family to leave the country.

Harry served in the US Army in the ski troops. He then attended the Brooklyn Polytechnic Institute in New York City, where he earned his degrees in chemistry: BS in 1949, MS in 1952, and PhD in 1955. He also studied at the Swiss Federal Institute of Technology (ETH) in Zürich. Harry's doctorate was directed by Rudolph Marcus, who later won a Nobel Prize in Chemistry. Harry was the first student to complete a doctorate under Marcus's direction, and his thesis involved kinetic studies on the reaction of diborane with amines; reaction rates were determined experimentally. In 1955, he began his postdoc with another Nobel prizewinner, Peter Debye, at Cornell University.



HARRY BRUMBERGER

Harry joined the Syracuse University chemistry department in 1957 as an assistant professor; he became an associate professor in 1962 and a professor in 1969. He was also a visiting scholar at the University of Graz in Austria, National Bureau of Standards, Weizmann Institute of Science in Israel, University of Cambridge in the UK, and ETH. In addition, he was a Fulbright grantee in India. Between 1969 and 1985 at Syracuse, he served as director of both the graduate biophysics program and the solid-state science and technology program.

Harry's research on small-angle x-ray scattering began at Cornell and continued at Syracuse. In the early days (from about 1955 to 1975), the available x-ray sources were of very low intensity and the detectors were primitive. Precise alignment and angular measurements were required. Harry, who carried out meticulous experimental measurements and took great care in interpreting results, quickly became an internationally recognized expert in the field.

Between 1957 and 1965, Harry helped to develop both the theoretical structure and the experimental procedure for the application of small-angle x-ray scattering to a variety of systems. He showed how, from the relatively featureless scattering curves, one could obtain particle sizes and interphase surface areas. Subsequently (1964–81), he carried out such measurements on alloys, glasses, polymers, DNA, proteins, thin films, multiphase systems, and solutions near their critical points. Among the multiphase systems, supported-metal heterogeneous catalysts were of particular interest. Then as now,