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# Foreword

## To the special Issue of the International Journal of Mass Spectrometry In Honor of Dr. Yong-Ki Kim

Yong-Ki Kim, widely known for the development and implementation of the Binary-Encounter-Bethe(BEB) theory for atomic and molecular collision data as well as for his pioneering work on fully relativistic atomic structure calculations, died on September 9, 2006 in an automobile accident while vacationing with his family in Alaska.

Yong-Ki was born on February 20, 1932 in Seoul, South Korea, received his primary education there and came to the United States in 1959. He received his Ph.D. from the University of Chicago under Prof. Roothaan in 1966 and then took a research position in the Radiological Physics Division at Argonne National Laboratory. In 1983, he accepted an offer from the Atomic Radiation Data Group at the National Bureau of Standards(NBS), now the National Institute of Standards and Technology(NIST), and directed this group from 1988 to 1995. From that time until his retirement in 2002 he was a senior physicist in the NIST Atomic Spectroscopy Group, and then continued to work at NIST as a part-time guest researcher, remaining as active and productive as ever.

Yong-Ki's career centered around three atomic physics areas, and in each of these he left his mark, achieving some breakthrough-accomplishments that should be useful to researchers for a long time to come. At Argonne, he closely collaborated with M. Inokuti on improving cross sections for inelastic scattering of charged particles by atoms and molecules, developing new expressions for the energy distribution of ejected secondary electrons, and developing a sum rule for the Bethe cross section.

He also kept up his strong interest in relativistic atomic structure theory and started close collaborations with J.-P. Desclaux and K.T. Cheng on the calculation of fully relativistic spectroscopic data, especially oscillator strengths, for highly charged ions. After calculating the first accurate relativistic oscillator strengths for the resonance lines of Li-, Be-, Na-, Cu,- and Ag-like ions, they produced in 1979 a large-scale calculation of transition probabilities for the persistent allowed and forbidden lines of the ions isoelectronic to the first-row atoms Li through F. This was the first comprehensive, accurate relativistic calculation, covering about 3000 energy levels and 10 000 transition probabilities, a standout at the time. It has been cited several hundred times and is still an important contribution to the NIST Atomic Spectra Reference Database. Yong-Ki then continued to refine and extend his work, applying it to other atomic sequences, for example, sulfur-like ions, and included extensive configuration mixing. He also treated the forbidden magnetic dipole and electric quadrupole transitions, considered quantum electrodynamic effects and worked out relativistic modifications of charge expansion theory.

After the relativistic atomic structure codes were fully established and sufficiently refined, Yong-Ki turned to a third area of atomic and molecular data. In 1994 he and M.E. Rudd of the University of Nebraska, collaborating closely, succeeded in developing a new theoretical model for describing electron-impact ionization, which they named the Binary-Encounter-Dipole model. This theory combines the Mott cross section for electron impact at low energies with the leading dipole part of the Bethe cross section at high impact energies. Their key idea was to combine the low and high energy approximations in such a way that they both have the correct asymptotic form at high energy as predicted by the Bethe theory, thus avoiding the introduction of adjustable parameters. The BED model requires, however, knowledge of the differential oscillator strength, a quantity which is not well known for most atomic and molecular species. Because of this difficulty, a simplified version of the BED theory, the Binary-Encounter-Bethe model (BEB), was developed, in which a hydrogenic differential oscillator strength is used. Nevertheless, this theory has produced remarkably accurate results, especially for molecules, as many comparisons with experimental data have shown. Encouraged by this success, Yong-Ki and co-workers have calculated ionization cross sections for about 100 molecules, covering numerous hydrocarbons, silicon and germanium hydrides, fluorocarbons, freons, boron compounds, atmospheric molecules and others, and in addition a few atoms and atomic ions. These numerical data are presented as one of the databases in the NIST Physical Reference Data website, and are currently visited at an average rate of 28 000 page requests per month.

Thus, Yong-Ki opened-up some important new atomic and molecular physics areas with his pioneering theoretical work. He followed up on this by producing a large amount of first-rate data, which are very valuable for the atomic, molecular, plasma and astrophysics communities. He communicated worldwide

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with many scientists, was always willing to help others with ideas and constructive advice, participated in numerous committees and was particularly active in the series of International Conferences on Atomic Processes in Plasmas, of which he organized the 1989 meeting at NIST. He was honored by the American Physical Society with a fellowship in 1979, received the Silver Medal of the U.S. Department of Commerce in 1987 and the U.S. Department of Energy Associate Award in 2003. His scientific output amounted to 127 papers, among them several book chapters.

At the time of his accident, he was still strongly engaged in extending and refining the BEB and BED theories, and was producing new data, informally leading a small group of theorists at NIST as well as collaborating with others in Japan, South Korea and Australia. His ideas and great physics insight will certainly be missed by the many colleagues who communicated and interacted with him from all over the world. The atomic and molecular physics community has suffered a great loss.

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