Order of Service

February 20, 2017
2:30pm
UGA Chapel
reception to follow at the Georgia Center, Hill Atrium

Musical Prelude (with slide show)

Processional — Family

Welcome — Dr. William M. Dennis
Professor and Head
UGA Physics & Astronomy

Surajit Sen
Professor
University at Buffalo – SUNY
Department of Physics

Loris Magnani
Professor
University of Georgia
Department of Physics & Astronomy

Todd Baker
Professor (retired)
University of Georgia
Department of Physics & Astronomy

Robert (Bob) Anderson
Professor (retired)
University of Georgia
Department of Physics & Astronomy

Closing — Dr. William M. Dennis
Professor and Head
UGA Physics & Astronomy

M. Howard Lee – Scientific Obituary

M. Howard Lee was born on May 21, 1937 in Pusan, Korea and passed away on November 18, 2016 after a brief illness. Howard was a theorist who studied statistical mechanics and many-body problems, and over the past 40 years the thrust of his work aimed to resolve challenging issues within the framework of statistical physics. In the core of his outstanding scientific legacy is the Recurrence Relations Method, through which fundamental aspects of many body dynamics within the linear response regime, such as ergodicity and irreversibility, were rigorously established. Other key contributions are unifying statistical mechanics of Fermi and Bose gases by polylogs and the definition of chaos from first principles. Howard's approach relied on physical intuition above mathematical techniques and was always very unique. His oft-stated conviction was that "there is a simple solution lurking amidst impossibly complicated problems."

Howard earned a BS in Chemistry from the University of Pennsylvania in 1959 and then moved to the Department of Physics and Astronomy where he got his PhD in 1967 under the direction of Marshall Luban. His dissertation was on the ground state properties of liquid Helium. After his PhD, he was a postdoc with D. D. Betts at the Theoretical Physics Institute at the University of Alberta in Edmonton from 1967-69, and then he collaborated with H.E. Stanley as a member of the Center for Materials Science at MIT from 1969-73. He arrived as an Assistant Professor at the University of Georgia in 1973 becoming a full professor in 1985 and a Regents Professor in 1999. Howard was named adjunct professor

at the Korea Institute for Advanced Study in Seoul in 1998. In addition, Howard was a Senior Fulbright Scholar at the Katholieke Universiteit Leuven from 1979-80 and a visiting professor at Seoul National University via the AID program in 1980. He was elected Fellow of the American Physical Society in 2001. His Fellowship citation read, "Developed the method of recurrence relations to study dynamic behavior in many particle systems. Established an equivalence between Fermi and Bose gases in two dimensions."

In the early 80s, he developed the analytical approach known as the Recurrence Relations Method, a physically appealing orthogonalization based process to solve the equation of motion for the Liouville operator. It allows the study of dynamics of Hermitian many-body systems in response to an external perturbation and, for either quantum or classical systems, the corresponding equation of motion can be exactly solved through it. Within this framework, the dynamical variable evolves in a realized Hilbert space and its trajectory draws a hypersurface whose geometry reveals the nature of the dynamics. Given this, Howard remarkably provided the missing physical interpretation for the geometric properties of a realized Hilbert space and a much clearer and simpler derivation of the generalized Langevin equation, first derived by Mori in a very formal way. The Recurrence Relations Method work had great impact on statistical physics, as evinced by the over 500 citations to the key papers. Since its publication in 1982 it has been employed to resolve a variety of dynamical issues emanating from condensed matter systems described by classical fluids, vibration chains, spin chains, as well as to electron liquids. For the Recurrence Relations Method work, he won the University of Georgia's Creative Research Medal in 1984. However, an even more impressive application of his method was still to come. In the 90s, Howard worked on unifying the statistical thermodynamics of ideal quantum gases by means of the mathematical functions known as polylogs. Confinement, equivalence and other physical properties have been established by means of these functions.

In the 2000s, Howard turned his attention to ergodic theory. On the strength of his Recurrence Relations Method he provided a physical theory for Boltzmann's Ergodic Hypothesis, one of the two foundations for statistical mechanics. He was particularly interested in the mathematical theorems of Birkhoff and Von Neumann that were considered too abstract for physical applications. With his great physics intuition, Howard developed a way to determine violations of Birkhoff's theorem for the Ergodic Hypothesis by using a mathematical tool he named the ergometer. With it, he showed how to gauge the validity of Boltzmann's Hypothesis in various situations. Often inspired by problems that he came across during his classroom teaching, in 2001 Howard published a paper on an analytical solution to chaos. It had not been thought that an exact analytic solution to chaotic dynamics could be possible. However, Howard developed a new mathematical technique for solving polynomials that occur in chaotic dynamics. By this technique he found the dynamic properties of a chaotic system could be mapped onto a many-body system. The isomorphic relationship allowed the introduction of his ergometric theory into chaos theory, thereby elucidating the connection between chaos and ergodicity. One of the most remarkable aspects of his career was that some of his best work came in the last two decades of his life. Howard was deeply committed to his teaching and his classes were widely attended. He was undoubtedly a beloved professor in the department by the graduate students and his classroom lectures (often described as group conversations) became legendary. In addition to his work with students in the classroom, Howard was in charge of determining the yearly graduate student prizes in the Department of Physics and Astronomy, a task he undertook very seriously and which meant a great deal to him. In particular, the annual Cummings Award, named for one of his former students was particularly special for him. As he lay in the hospital giving instructions of what should be done in the event of his death, his foremost concern was the management and continuation of the graduate prizes. He deemed his unfinished papers and books only of "personal interest and thus not very important." It is rare to find a great physicist who is also a kind and wise person. M. Howard Lee was all this, he was a true gentleman and an inspiration, and he will be long remembered by all who knew him and miss him dearly.

Loris Magnani and Robert L. Anderson, *University of Georgia*
Érica de Mello Silva, *Federal University of Mato Grosso, Brazil*
Surajit Sen, *University at Buffalo – The State University of New York*
Jongbae Hong, *Seoul National University, South Korea*