IN MEMORIAM

HANS JOACHIM LIEBE (1934-2012)

Hans Joaquim Liebe, an internationally recognized expert in radio wave physics and developer of the widely-used Millimeterwave Propagation Model (MPM), passed away peacefully on August 2, 2012, after a long and courageous battle with Parkinson's disease. He was the son of Margarete and Fritz Liebe, and was born in Insterburg, East Prussia, Germany, on January 21, 1934. He married Roswita Borgwardt in 1963 and they were married 49 years. In 1964, he graduated magna cum laude from the Technical University of Berlin where he earned the Ph.D. degree in Electrical Engineering. In 1965, he moved from Germany to the United States with his family.

Dr. Liebe worked for the Institute for Telecommunications Sciences (ITS) in Boulder from 1966 until his retirement in 1995. Dr. Liebe was awarded the Senior U.S. Scientist Humboldt Award (1976), Department of Commerce Silver Medals (1984 and 1991) for meritorious service and outstanding publications, and the IEEE Harry Diamond Memorial Award (2002) for distinguished technical contributions in the field of millimeter wave propagation. Dr. Liebe was a Life Fellow of IEEE and a member of the US National Committee of International Union of Radio Science(USNC/URSI), Commissions A and F.

Dr. Liebe, over many years of continued study, developed reliable expressions for the complex refractivity of moist air that is basic to all millimeter and sub-millimeter wave propagation problems, inclusive of those in communications, navigation, and remote sensing. During the course of this model development, Dr. Liebe overcame many experimental difficulties and, to a large extent, verified the overlap between spectroscopic measurements and field measurements. His publications included basic studies of the absorption by gaseous water vapor and oxygen, and well as absorption by liquid water. In his thirty-year effort to obtain valid data on atmospheric loss and delay properties, he obtained a model that is highly accurate from RF frequencies up to approximately 1000 GHz. This model is in widespread use today in applications as diverse as weather forecasting, satellite broadcasting, and radar.Dr. Liebe's work

has been and remains vital to the remote sensing community, where almost all ground- and satellite-based microwave and millimeter radiometric techniques take advantage of his models. His more recent work on cloud absorption is also becoming increasingly important, as will the work on Zeeman splitting of the O_2 absorption lines at mesospheric altitudes.

Dr. Liebe's meticulous work and models are widely recognized throughout the global scientific community. He established a reputation for accurate measurements within 20 to 100 GHz well before commercial equipment was widely available in this range. He used spectroscopic theory to extend his estimates up to 1000 GHz, where there were very few reliable measurements available and at a time when very little quantitative knowledge of absorptive and refractive spectra was available in this spectral range. His work is nowadays the basis for remote sensing techniques currently being used for or considered for major airborne and spaceborne campaigns, including the geosynchronous microwave imager/sounder instrument and passive submillimeterwave cloud ice mass sensors. Dr. Liebe's work constituted both outstanding science and a substantial contribution to radio wave propagation practice, as exhibited, for example, by the adoption of his work by the '*International Telecommunication Union Study Group III of ITU-R*'.

Hans' careful attention to the development of the MPM propagation model was only superceded by the warmth of his personality - which was equally well known among his colleagues. In addition to his world-class technical achievements, Hans was a loving father and husband who cherished spending time with his family in the great outdoors. He was an avid swimmer, hiker, skier and tennis player. In addition to his wife of 49 years, Roswita, he leaves behind his two daughters, Christi Liebe (Jon Gilbertson) of Carnation, WA, and Annette Liebe (husband Scott MacLowry), and granddaughter Isabel Rose all of Bend, OR and a sister, Elvira Christians of Berlin, Germany.

Edited by Albin J. Gasiewski and Ed R. Westwater, Department of Electrical, Computing, and Energy Engineering, University of Colorado at Boulder.