

Microwave Pioneer Award

This award recognizes an individual or team for outstanding and pioneering technical contributions that advanced microwave theory and techniques. This year's Microwave Pioneer Award goes to **Erik Kolberg**

"For pioneering contributions to THz Science and Technology"



Erik L. Kollberg

Erik Kollberg was born in Stockholm midsummer 1937. 1964 he married Ulla and they have three children and six grandchildren. He received PhD from Chalmers University Technology, Gothenburg in 1970 and became a full professor at Chalmers 1979. Throughout his career he has been devoted to development of ultra low noise receivers for millimeter and submillimeter wavelengths. The title of his PhD thesis was "Rutile Travelling Wave Maser Systems for the frequency range 1.3-6.2 GHz and Radio Astronomy Application". Kollberg's research was focused on development of low noise millimeter and submillimeter wave devices and systems aimed for radio astronomy applications. He was responsible for the Onsala Space Observatory receiver group and occasionally he participated in radio astronomy observations. He was deeply involved searching and subsequently discovering CH molecules in interstellar clouds.

He was rewarded an honorable doctorate at the Helsinki University of Technology 2000. He received several honorable rewards, e. g. he was invited to California Institute as a Fairchild scholar in 1990. He is a member of the Royal Swedish Academy of Science (which decides on who will achieve the Nobel price in physics). He was invited as a guest professor at École normale supérieure, Paris. He was active in many influential scientific organizations. He is Fellow of IEEE.

Kollberg developed maser amplifiers from 0.8 to 35 GHz and they were all used at Onsala. In particular the 35 GHz maser is interesting due to the new innovative image line slow wave structure.

However astronomers required receivers for higher frequencies. Schottky diodes based on III-V materials (GaAs, InAs etc) were developed and used in 100 GHz mixers. Cooled HEMT amplifiers were essential in realizing low noise IF amplifiers for mixer receivers.

Much improved mixer performance was achieved when SIS (Superconductor Insulator Superconductor) devices with a stronger nonlinearity in the current-voltage were introduced. Thanks to a fruitful cooperation with the physics department at Chalmers mixers for frequencies from 40 to 115 GHz were readily developed.

Another fruitful cooperation was established with a Russian group of researchers resulting in early demonstration of the low noise HEB (Hot Electron Bolometer) mixer. HEB mixers were developed around 1.5-3 THz with receiver noise temperatures of about a few 100 K. Interestingly Kollberg showed for the first time agreement between theoretical and experimental noise temperature. It is obvious that quantum noise is an important and unavoidable noise contribution. Kollberg's group supplied the ESA submillimeter space telescope Herschel with HEB mixers.

In implementing a mixer a local oscillator it is necessary but not easily realized. For submillimeter receivers multipliers are frequently used. Kollberg invented the heterostructure barrier varactor diode (HBV). Due to the symmetry of the capacitance vs voltage relation only odd harmonics are present allowing a great simplification in designing multipliers.

It should be pointed out that a large number of collaborators have contributed to the results shown above.