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### ULTRA-LOW-NOISE, InP FIELD EFFECT TRANSISTOR RADIO ASTRONOMY RECEIVERS: STATE-OF-THE-ART

**Marian W. Pospieszalski**

*National Radio Astronomy Observatory*

**Date: Wednesday April 11th, 2012**

**Time: 5:30 Reception, Dinner (Optional) 6:00 pm, Lecture 7:00**

**Place: Mitre Building 2**

**Directions:** [http://www.mitre.org/about/locations/va\\_mclean\\_mitre2.html](http://www.mitre.org/about/locations/va_mclean_mitre2.html)

**Free parking.**

**All IEEE members and guests are welcome to attend.**

**Cost: Lecture and reception free, Dinner \$15**

**Please RSVP to Roger Kaul, 301-394-4775 or [rogerieemtt@gmail.com](mailto:rogerieemtt@gmail.com) by April 9th**

**Pospieszalski photo**



**Abstract:**

In the early 1970's, the ultra-low-noise receiving systems employed mainly solid-state masers, cryogenically-cooled parametric amplifiers (or converters) and Schottky diode mixers. At the end of that decade, advances in GaAs FET technology, combined with cryogenic cooling, made the noise performance of GaAs FET amplifiers competitive with the noise performance of parametric amplifiers and masers. Indeed, improvements in the noise temperature of field-effect transistors (FET's) and, later, heterostructure field-effect transistors (HFET's) over the last several decades have been quite dramatic. In 1970, a noise temperature of 120 K was reported at 1 GHz and physical temperature of 77 K; in 2003, noise temperatures of 2, 8 and at 35 K were reported at 4, 30 and 100 GHz, respectively, for physical temperatures of 14 to 20 K. These last results were achieved with InP HFETs. Broadband amplifiers using these devices have been successfully used in a number of instruments for radio astronomy research. These include: Very Large Array (VLA), Very Large Baseline Array (VLBA), Green Bank Telescope (GBT), Wilkinson Microwave Anisotropy Probe (MAP), Planck Low Frequency Instrument and several ground-based instruments for the investigation of cosmic microwave background. Against this background, the presentation will focus on the following main topics:

Noise models of microwave transistors and their general properties common to all field effect (FET)

and bipolar transistors (BT)

Noise and signal properties of InP heterostructure field effect transistors (HFETs) at cryogenic temperatures

Design and examples of realizations of wideband, low-noise, cryogenically-coolable HFET amplifiers in 1 to 115 GHz range

Examples of realizations of receivers for interferometric arrays

Examples of realization of very broadband continuum radiometers

In conclusion, thoughts on future developments in low-noise amplifier technology will be offered. Especially a question whether rapidly advancing technologies of microwave heterostructure bipolar transistors (HBT's) and CMOS can in the future offer alternatives to the extremely low noise performance of InP HFET's will be addressed.

### Speaker Biography:

Marian W. Pospieszalski was awarded the M.Sc. and D.Sc. degrees in electrical engineering from the Warsaw Institute of Technology, Warsaw, Poland, in 1967 and 1976, respectively.

From 1967 to 1984, Dr. Pospieszalski was with the Institute of Electronics Fundamentals, Warsaw University of Technology (WUT), during which time he held visiting positions with the Electronics Research Laboratory, University of California at Berkeley (1977-1978), the National Radio Astronomy Observatory (NRAO), Charlottesville, VA (1978-1979), and the Department of Electrical Engineering, University of Virginia, Charlottesville, VA (1982-1984). Since 1984, he has been with the NRAO Central Development Laboratory, presently as Scientist with tenure. While on leave during 2001-2002, Dr. Pospieszalski was Chief Scientist-Microwave at Inphi Corporation, Westlake Village, CA, a company working on high-speed circuits. His research interests are in the fields of microwave, millimeter-wave, and high-speed circuits and systems.

At NRAO, Dr. Pospieszalski has been involved with the theory and design of low-noise devices, amplifiers, and receivers with emphasis on the properties of field-effect transistors (FETs) at cryogenic temperatures. This work has resulted in the lowest noise HFET amplifiers and receivers ever reported in the 1 to 120 GHz range.

Dr. Pospieszalski has authored or co-authored over ninety journal and conference papers. He has been a member of the IEEE Transaction on Microwave Theory and Techniques (MTT) Editorial Board since 1987, and a member of the IEEE MTT Society Technical Committee on Microwave Low-Noise Techniques since 1992, serving as Chair of that Committee from 2001-2004. Also, he has been a member of the Technical Program Committee of the International Microwave Symposium since 1992, a member of URSI Commissions D and J and has served as a reviewer for many journals.

In 1977, Dr. Pospieszalski received the Award of Minister of Science, Technology and Higher Education (Poland) for scientific achievements. In 1992, he was elected Fellow of IEEE. In 2002, he received the NRAO Distinguished Performance Award, and in 2006 the Microwave Application Award from MTT Society.

**New Local Chapter Administrative Committee members are needed. Really. If you are reading this sentence, then we need you to help us in the Chapter.**

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**Please contact 2011-12 Chapter Chair Michael Nueslein [mnueslein@mitre.org](mailto:mnueslein@mitre.org)**

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