**Southeastern Michigan Section**
**"Chapter IV" Speaker Series**
**Fri., December 10, 2010, 10:00 am**
**Room #1690, CSE Bldg,**
**North Campus, University of Michigan**
**1301 Beal Ave, Ann Arbor, MI**

# "Terahertz Electronics"


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**Abstract:**

Terahertz electronics holds will enable and expand numerous applications of terahertz technol-ogy that now mostly relies on expensive THz photonics setups. These applications include detection of explosives and biological and chemical hazardous agents, scanning for building and airport security, and applications in radio astronomy, space research, biology and medicine. Conventional THz electronics is based on two-terminal devices, such as Gunn and Schottky diodes. Emerging THz transistor technology uses hort channel Si CMOS and FIN FETs, InGaAs-based Heterostructure Bipolar Transistors (HBTs) and High Electron Mobility Transistors (HEMTs) that have already reached cutoff frequencies in the THz range. GaN-based FETs has additional advantages at THz frequencies of operation compared to Si or III-V transistors but they might require a different (5 terminal) design. For all materials systems, the device feature sizes have shrunk to the point, where ballistic mode of electron transport becomes important or even dominant. At THz and sub-THz frequencies, the ballistic transport also affects devices with relatively large (submicron) feature sizes. THz radiation excites the oscillations of the electron density in transistor channels. These oscillations (called plasma waves) propagate with velocities much larger that electron drift velocities and have frequencies in the THz range even for devices with feature sizes exceeding a few hundred nanometers The rectification of plasma waves by the device nonlinearities can be used for detecting THz radiation and for imaging and in-situ testing of transistor structures. In very short devices, plasma waves become unstable and cause THz emission. Plasma wave electronics detectors and sources are tunable by applied bias voltage and can be modulated at very high frequencies, approaching or even exceeding transistor cutoff frequencies. Using synchronized THz plasmonic transistor arrays is expected to yield dramatic performance improvements of THz electronic detectors and sources and rejuvenate THz electronics.


**Speaker's Biography:**

Michael Shur received his M. S. E. E. degree (with honors) from St. Petersburg Electrotechnical Institute, and Ph. D. and Doctor of Science degrees from A. F. Ioffe Institute. He has held positions at Ioffe, Cornell, Oakland University, University of Minnesota, and University of Virginia, where he was John Money Professor and served as Director of Applied Electrophysics Laboratories. He is now Patricia W. and C. Sheldon Roberts'48 Professor of ECSE, Professor of Physics, and Acting Director of Center for Integrated Electronics and co-Director of the NSF I/UCR Center "Connection One". Dr. Shur is a Fellow of IEEE, APS (life), MRS, ECS, WIF, AAAS, and EIT, Life Member of IEEE MTT, SPIE, Sigma Xi, and of Humboldt Society of America, Member of Eta Kappa Nu, and Tau Beta Pi, Electromagnetic Academy, and ASEE, an Elected Member and former Chair of US Commission and elected Member of NRC of URSI (2003-2004). Dr. Shur is Editor-in-Chief of the International Journal of High Speed Electronics and Systems and of the related book series, Regional Editor of physica status solidi, and Vice-President for publications of the IEEE Sensors Council. Several of Dr. Shur's publications received the best paper awards. Among his other awards are Technical Achievement Award from IEEE Sensors Council, IEEE Donald Fink Prize, IEEE Leon K. Kirchmayer Award, an Honorary Doctorate, the Gold Medal of the Russian Ministry of Education, van der Ziel Award, Senior Humboldt Research Award, Pioneer Award from Compound Semi, RPI School of Engineering Research Award, and Commendation for Excellence in Technical Communications. Dr. Shur is listed by the Institute of Scientific Information (ISI) as one of the Highly Cited Researchers. He is co-founder of Sensor Electronics Technology, Inc – the first commercial supplier of deep UV LEDs and the winner of the Palmetto Pillar Award for Technology Development and Prism Award for the most innovative photonics product. He is Foreign Member of the Lithuanian Academy of Sciences.