

# Terahertz Technology and its Applications

Goutam Chattopadhyay

NASA-Jet Propulsion Laboratory, California Institute of Technology  
4800 Oak Grove Drive, Pasadena, CA 91109, USA.

For more than last forty years, terahertz components and instruments have primarily been developed for space science applications in radio astronomy and planetary sciences. However, in recent years, terahertz waves are increasingly being used in commercial applications such as high speed communications, security imaging, autonomous landing and refueling of airplanes, and medicines. In spite of all these fascinating scientific and commercial potential, the terahertz frequency range (loosely defined as  $300 \text{ GHz} < \nu < 10 \text{ THz}$ ) still remains one of the least utilized electromagnetic bands because of the unavailability of commercial source and sensor components, and sub-systems.

Recent progress in CMOS technology as well as availability of InP HEMT based amplifiers in terahertz frequency band has caught the imagination of researchers for developing terahertz instruments for commercial applications. Rapid progress in multiple fronts, such as commercial software for component and device modeling, low-loss waveguide circuits and interconnect technologies, silicon micromachining for highly integrated and compact packaging, and submicron scale lithographic techniques, is making it an exciting time for terahertz engineers and scientists.

In this presentation, an overview of the state of the terahertz technology will be presented. The talk will detail the science and other applications that specifically require technology at terahertz frequencies. The challenges of the future generation instruments and detectors at these frequencies in addressing the needs for critical scientific and commercial applications will also be discussed.

The research described herein was carried out at the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA, under contract with National Aeronautics and Space Administration.

©2015 California Institute of Technology. Govt. sponsorship acknowledged.

## Goutam Chattopadhyay Biography:



Goutam Chattopadhyay is a Principal Engineer/Scientist at the NASA's Jet Propulsion Laboratory, California Institute of Technology, and a Visiting Associate at the Division of Physics, Mathematics, and Astronomy at the California Institute of Technology, Pasadena, USA. He received the Ph.D. degree in electrical engineering from the California Institute of Technology (Caltech), Pasadena, in 2000.

His research interests include microwave, millimeter-, and submillimeter- wave heterodyne and direct detector receivers, frequency sources and mixers in the terahertz region, antennas, SIS mixer technology, direct detector bolometer instruments; InP HEMT amplifiers, mixers, and multipliers; high frequency radars, and applications of nanotechnology at terahertz frequencies. He has more than 200 publications in international journals and conferences and holds more than fifteen patents. Among various awards and honors, he was the recipient of the Best Undergraduate Student Award from the University of Calcutta in 1987, the Jawaharlal Nehru Fellowship Award from the Government of India in 1992, and the IEEE MTT-S Graduate Fellowship Award in 1997. He was the recipient of the best journal paper award in 2013 by IEEE Transactions on Terahertz Science and Technology, and IETE Prof. S. N. Mitra Memorial Award in 2014. He also received more than 30 NASA technical achievement and new technology invention awards. He is a Fellow of IEEE (USA) and IETE (India) and an IEEE Distinguished Lecturer.