

## Terahertz in Space and Applications on Earth

Historically Terahertz (THz) applications have focused on the identification and mapping of light weight gases and molecules present in the cold, low pressure environments in and around regions of new star formations, gas and dust in the galaxy, the sphere encompassing the early universe, the atmospheres of planets and small solar system bodies (moons and comets) and the upper atmosphere of the Earth. Seventeen space missions have already completed observations in this energy rich region of the electromagnetic spectrum which boasts 98% of all the photons in the universe. In more recent times, especially after the advent of THz pulsed time domain spectroscopy, applications of this far infrared wavelength regime have spread into many new areas of technology. Most prescient is the recent interest in THz imaging and spectroscopy for security applications. The largest commercial driver for THz, however, is likely to be in communications, and if early results are proven to hold up, THz radiation may have substantial impact on biological function.

The tutorial will begin with a review of traditional THz applications being pursued for Space, Earth and Planetary science. Focus will be on science drivers and successfully fielded instruments. Attention will then turn to THz technology and instruments with a focus on high speed devices and circuits for sensor and source applications. Next, a look will be taken at a wide range of new applications for THz techniques from ground based spectroscopy to defense and security and finally in the life sciences. Emphasis will be placed on programs in which the speaker has been personally involved.

### Peter Siegel – Biography



Peter H. Siegel holds appointments as Faculty Associate in Electrical Engineering and Senior Scientist in Biology at Caltech and Technical Group Supervisor, Senior Research Scientist and Principal Engineer for Submillimeter Wave Advanced Technology (SWAT) at the Jet Propulsion Laboratory in Pasadena, California. He has been working in the areas of millimeter and submillimeter-wave technology and applications for nearly 35 years and has PI'd or co-I'd more 75 R&D programs and been involved in four major space flight instruments. Dr. Siegel has authored more than 275 papers in THz technology and applications and has been awarded more than 60 NASA certificates of recognition for his technical contributions. Among many other duties, he founded and chairs the International Society for Infrared, Millimeter and Terahertz Waves, the oldest and largest venue devoted to the field of far IR techniques, science and applications. Dr. Siegel is a Fellow of IEEE and has served as an IEEE Distinguished Lecturer and co-chair and chair of MTT Committee 4 – THz Technology and applications. His current interests are split between traditional Earth, planetary and astrophysics applications and new THz applications in medicine and biology.

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