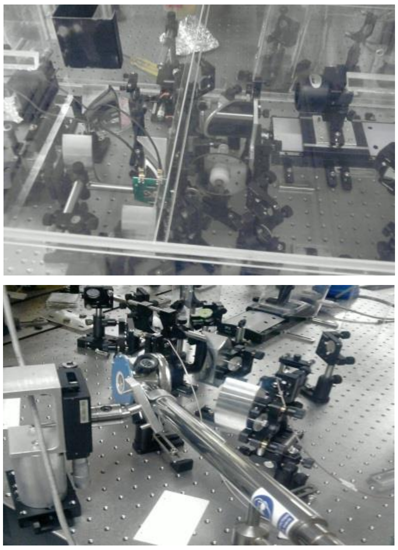
Fundamental Optics, THz & Optical Nanostructures



Two home built THz setups for performing transmission (box enclosed) and reflection THz.

Welcome to Foton Lab: THz Activity

In Ultrafast Optics and Tera-Hertz (THz) Spectroscopy activity, Foton lab at TIFR primarily investigates ultra-fast phenomena, carrier dynamics and various optical phenomena involving THz radiation. Several biological and chemical molecules have vibrational frequency lines falling in the THz regime. Several materials exhibit exotic properties which are due to their rearrangement of charge carriers. These properties change with temperature, electric field or magnetic field or under optical fluence. THz radiation measures conductivity these carriers. Our lab aims to tackle the basic challenges to understand these processes with homebuilt sources, detectors and setups.

Tools & Techniques

Our experiments are carried out at temperatures varying from 320K up to 10K, achieved using a closed cycle helium refrigerator. The THz (antenna) sources and detectors are made out of Gallium Arsenide (GaAs) wafers using conventional photo- or nano-lithography in a cleanroom. We use ultra-short pulsed laser (10fs, 800nm, 80MHz) for exciting carriers in GaAs to generate THz signal. The generated THz pulse (~1ps duration) is used to study our samples. We also fabricate necessary components for THz optics which are not available.

CURRENT MEMBERS:

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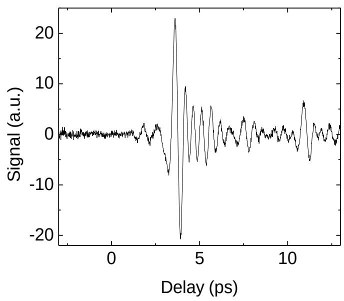
THz Spectroscopy (10^{12}Hz)

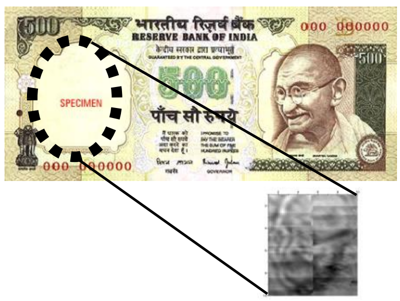
The THz radiation has wavelengths from 30 microns (10THz) to 1000 microns (0.3THz) as opposed to visible (0.4 to 0.7 microns). This is the final frontier in electro-magnetic spectrum which needs to be explored in terms of high power sources, sensitive detectors and spectroscopy setups. One of the central challenges in building such a system is, high intensity sources or detectors are not available. We don't yet know how to make them! So we try various designs for increasing the THz emission and detection efficiency. This requires study of several different types of materials and charge carrier dynamics in them is possibly the key for solving this problem. The spectroscopy has several applications from medicine to condensed matter physics and the field is wide open.

Applications

Some of the exotic materials or molecules have very interesting properties which are related in turn to the way charge carriers are arranged or the way they respond to external stimulation. THz spectroscopy can tell a lot about conductivity response of such carriers. We can record the amplitude of the THz light field, how it oscillates in femtosecond (10^{-15} sec) time scale. When passing through the sample it changes appropriately revealing all the information. We are interested in studying this information and improve our understanding.



A Typical THz Pulse waveform recorded in our laboratory. The entire pulse duration is in few picoseconds.



India's First THz Image of Father of our nation which we have taken in our lab in TIFR from 500Rs currency watermark.