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The potential of THz-TDS diagnostics for next step Fusion experiments

The Terahertz (THz) band of the electromagnetic spectrum is nowadays defined as a range of frequency [0.1-10] THz, between microwaves and mid-infrared electromagnetic radiation, where electronic and optical technologies overlap. The last decade has seen an enormous development of spectroscopy techniques in this area, with the full development of the so-called Time Domain Spectroscopy (TDS). The use of the wide range of frequencies associated with a probing THz pulse generated by a femtosecond pulse laser via spark-gap emitters, permits the determination of several sample parameters simultaneously, both in transmission and reflection. This possibility has obvious potential in the area of Far Infrared and millimeter waves plasma diagnostics One of the most promising diagnostic applications of THz-TDS is interferometry. A THz-TDS spectrometer with emitter and receiver located at the opposite ends of a vertical chord, using several spectral components of the THz beam, will provide the same information of a classic interferometric and in addition a straightforward implementation of the combined measurement of interferometry and polarimetry.

A more challenging diagnostic application of THz-TDS comes with reflectometry. The THz TDS reflectometer will be an evolution of the Ultrashort Pulse Radar technique, with the broadband spectrum required for the diagnostic obtained through a Terahertz switch.

The THZ diagnostic development is now progressing along the lines of transition from table top THz-TDS spectroscopy to plasma diagnostics on a tokamak. This will require a complete change of geometrical arrangements, optical layouts, spatial and temporal scales of the measurements.

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