Checking people at airports -- with terahertz radiation

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Within the last few years the number of transport checks – above all at airports – has been increased considerably. A worthwhile effort as, after all, it concerns the protection of passengers. Possibilities for new and safe methods of transport checks are offered by terahertz radiation.

Before this radiation can be used for this purpose, however, it has to be measured quantitatively, so that damage to health caused by radiation can be ruled out. The exact measurement of this type of radiation has now been successfully undertaken by the Physikalisch-Technische Bundesanstalt (PTB), the German national metrology institute, for the first time.

Radiation in the THz range (with wavelengths from 30 µm to 3000 µm and frequencies from 0.1 THz to 10 THz) penetrates clothing and many other organic materials and furthermore offers spectroscopic information on safety-relevant materials such as explosives and pharmacological substances.

The broad spectrum of the possible applications extends from security check to the investigation of the spatial and/or time structure of the electron packages in the storage rings for synchrotron radiation production and in free-electron lasers, for which the receivers of the German Electron Synchrotron DESY characterized here are used.

The complete information on the THz spectra can only be determined with detectors of known spectral responsivity. Up to now, the integral

responsivity of the respective detectors and their spectral distribution are still largely unknown. The PTB has now for the first time determined the spectral responsivities of two THz detectors in the wavelength range from 50 µm to 600 µm with the aid of cavity radiators.

In order to make available spectral radiation fluxes in the THz range, calculable according to Planck's radiation law, the PTB uses two THz cavity radiators at different temperatures in connection with THz band and longwave-pass filters. The interior surfaces of the radiators are provided with a special coating which possesses a known and high emissivity also in the THz range and thus enables the calculability of the radiation incident on the detector. In order to obtain a sufficiently spectral purity of the THz radiation, a suppression of the infrared radiation of more than nine orders of magnitude is necessary.

By using an FT-IR spectrometer, the transmittance for all filter combinations used was accurately determined in the wavelength range from 0.8 µm to 1700 µm. Due to the calculable radiation of the cavity radiators and the known transmittance of the filters, it is possible to accurately determine the spectral radiation fluxes and thus determine the spectral absolute responsivities of THz receivers for the first time. Such absolutely characterized receivers will in future be utilized, e.g., both at the Metrology Light Source of the PTB to investigate the THz radiation produced there and in the investigation of the effect of THz radiation on the biological cell cycle.

Source: Physikalisch-Technische Bundesanstalt