Terahertz Memos

Memo 02

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Choice of Frequencies for THz Atmospheric Transmission

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Some THz applications require transmission through the atmosphere, perhaps for kilometers. Such applications include commincations and radar. While radar means radio detection and ranging, one might call a THz radar as a tedar (Terahertz detection and ranging).

What is meant by THz range of frequencies various among authors. Historically, it is intdended to cover a technological gap between infrared and optical frequencies. One might take

$$0.1 \text{ THz} < f < 10 \text{ THz} \tag{1}$$

as a traditional definition, but others might start at a higher frequency such as 0.2 THz (200 GHz).

Measurements have been made of terahertz propagation (attenuation) through both dry and moist air [1]. Reading from the graphed data we find some interesting frequencies (minima in the attenuation curves).

Table 1: Attenuation of the Electromagnetic Waves at favorable frequencies

Frequency	Attenuation (dB/Km)
80 GHz	$0.3 - 4$
0.205 THz	$2 - 10$
0.300 THz	$4 - 12$
0.405 THz	$15 - 30$
0.680 THz	$50 - 100$
0.880 THz	$40 - 100$

In the presence of rain, the attenuation is slightly increased over the upper values.

The 0.2 THz trough extends fairly flat through 0.3 THz. Since beam collimation is inversely proportional to wavelength, it would probably be best to choose the highest frequency within the attenuation trough (transmission window), e.g., 0.3 rather than 0.2 THz. The 0.4 THz trough may also be used if the range is to be 2 km or less. Therefore a frequency of 0.3 THz is most appropriate if one wishes to transmit over km ranges (and perhaps scatter back in a tedar sense). Going higher than 0.4 THz leads to severe attenuation.

References

[1] R. W. McMillan, "Terahertz Imaging, Millimeter-Wave Radar." pp. 1-26 in J. Byrnes (ed.), Advances in Sensing with Security Applications, Springer, 2006.