DIELECTRIC PROPERTIES OF DUST IN SUB-TERAHERTZ REGION OF SPECTRUM.
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Introduction: A dust is an important constituent of solar system bodies and the interplanetary space. Properties of a few meters of dust under surface of bodies are most significant for exploration of Solar System. Investigations of this layer by astronomical instruments and by remote sensing from spacecrafts is restricted by absorption of electromagnetic radiation, which is defined by imaging part **ε″** of the dielectric constant of dust.

Spectral region approximately from 30 GHz to 3 THz correspond to penetration depth from parts of millimeter to meters. An existing approach to use dielectric properties of a bulk materials of proper mineral compositions for reduction of observation is not accurate for application to dust consisting of agglomeration of solid nanoparticles. A difference in absorbivity could be more than order of magnitude.

An analysis of dust properties was made on base of physics of amorphous solids considered in publication [1] pointed mainly on interstellar dust.

Dust specific dielectric properties: A dust is a highly disordered substance. It leads to braking of selection rules in electromagnetic transitions, which are known from solid-state physics. First, it leads to sufficient interaction of electric field with acoustic-type oscillations. In the second place, irregularities in the media generate a number of local states, which energies are comparable with that of quanta $h\nu$ in a mentioned spectral domain.

Both effects put into dielectric constant **ε.** The change of a real part ε′ is small in comparison with a static value of ε, defined mainly be electronic and ionic polarization. A dominating value is a contribution to the frequency dependent part ε″(ν), which define an absorption coefficient

$\alpha(\nu)= \varepsilon''(\nu)\cdot 2\pi\nu\cdot c^{-1}(\varepsilon')^{-1/2}$.

The first effect leads to an absorption $\alpha(\nu) \sim \nu^2$ in a high frequency part of the region, and to $\alpha(\nu) \sim \nu^4$ in the low frequency part. A frequency dividing these parts depends on length of correlation of charge distribution in a media. This absorption is temperature independent.

The second effect produces less intensive absorption in high frequency part of spectrum. It is temperature dependent and has more complicated spectrum. It corresponds to effects of so called “two level systems” or “tunnel states” responsible for excessive thermal capacity in low temperature experiments.

Quantative values of absorption have no direct relation to chemical composition of a substance. They are linked significally with a degree of irregularity of dust. Therefore it is probable that these properties of cosmic dust are very different from that of terrestrial dust and solids. It could follow from different nature of their origin, particularly connected with such processes as destruction of solid minerals or very different sequence of coagulation of porous grains beginning from nanoparticles in presolar nebula.

References: [1] Meny, C., Gromov, V. et al. (2007) *Astronomy and Astrophysics 468, 171-188.*