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Optical Transmittance of Ultra-Diluted Gas

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About the Study

This paper proposes a model of light transmission of ultra-lean gas, taking into account the nonlocality of gas particles, the quantum effect of wave function diffusion derived from solving the Schrodinger equation of free particles. A significant increase in the permeability of such gases is expected compared to the classical predictions. Several quantitative and qualitative results of the model have been shown and counterfeit experiments have been proposed. The classical Lambert-Beer equation is derived from a model within its scope. There are comments on some astrophysical phenomena and possible interpretations of quantum mechanics. Experiments that match the predictions of this model are referenced.

Appropriate models of light gas interactions are crucial in many areas of science such as astrophysics, atmospheric science, chemistry, and cosmology. There are many theories that explain the transmission, absorption, scattering, and other phenomena of electromagnetic waves that pass through a particle cloud. One of the oldest is Beer-Lambert's exponential transmission law. This explains the attenuation of monochromatic light by a homogeneous, low density medium. It is still used in many applications, primarily quantitative spectroscopy. The latest models are much more advanced. They are in the form of transfer equations. They can be applied to non-heterogeneous media. Some of them are derived directly from Maxwell's equations. Some cover multiple scattering. As far as we know, this type of theory is most often derived from some type of ideal gas model. Gas particles are treated as small local units of finite size.

A model for measuring ultra-lean gas permeability. It is assumed that a gas molecule with a sufficiently long mean free time must follow the Schrodinger equation for free particles with non-relativistic limits. Particle-free time is the time between interactions with particles. That is, the interaction with a photon or another particle. In this way, the potential term of the Schrodinger equation can be discarded and the free particle equation can be applied. A well-known solution to this equation shows the spatial expansion of the wave function of a particle over time. Our aim is to investigate how the measured transmittance is affected by the rate of scattering and the size of the photodetector. Moreover, more and more experiments convince us that quantum mechanics is not a locally realistic theory, so we assume the nonlocality of the wave function.

The proposed model shows the interesting property that the measured permeability increases with the mean free time of the particles, even though the gas density is kept constant. It has also been shown that the measured transparency of clouds depends on the size of the detector and the intensity of the background radiation to which the gas cloud is exposed. Various astrophysical phenomena may be associated with these properties. Various counterfeiting experiments have been proposed, including benchtop experiments. In addition, the limitations of the application of some classical laws have been pointed out.

Conclusion

In the proposed model, the internal structure of the gas particles is discarded. Treat each particle as a single independent Gaussian wave packet of a particular mass. The geometric cross section of photon particle scattering is used later in the work to simplify the internal details of the process that affects photon propagation. This is justified because the final transmission model is related to a cloud of particles.

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