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FORMATION OF VACUUM CAVITIES IN THE ATMOSPHERE BY METHODS OF LASER OPTICS OF NEUTRAL PARTICLES

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A method is proposed for establishing cylindrical vacuum cavities in the Earth's atmosphere by laser field with an artificially created gradient of intensity and of frequency. As distinct from the method of generation of vacuum cavities in the atmosphere realized in the U.S.A. (the HAARP program), in the new method the dimensions of cavities and energy expenditure for their formation are substantially smaller while the spectrum of applications is much wider. The time of formation and dimensions of the vacuum cavities may reach values permitting to improve the quality and range of action of laser communications and optical location, and to diminish the aerodynamic drag of flying vehicles at comparatively low energy consumprion.

A decrease in aerodynamic drag of flying vehicles (FV), an increase in the range of action and improvement of quality of laser communication and optical location, creation of radically new transport means and, hence, qualitatively new resolutions to the problems of energetics and ecology — all this represents only a few advantages, which may open with resolution of the complex and many-sided problem of creating vacuum cavities (VC) in the atmosphere and their movement in the air space by means of lasers.

Large-scale (1–3 thousand km) perturbations in the atmosphere, arising from powerful microwave radiation at an altitude of 60–1000 km (the HAARP program) necessitate large energies, are accompanied by formation of plasma and dramatic rise of temperature.

The recent investigations [2, 3] in the control of motion of atoms and molecules by laser light, as well as creation of new powerful lasers [4] laid the basis for resolving the problem of arrangement of protracted (1 to 100 m) vacuum cavities by the methods of laser optics of neutral particles.

The method of VC described below assumes application of the gradient laser field adjustable in frequency, whose space-time structure and magnitude, in case of interaction with the air, prevents formation of the plasma (the light flux intensity $I < 10^{13}$ W/m^2) and of the leading edge shock wave (in the problem of reduction of aerodynamic drag of FV).

The use of intensive gradient-type laser field for creating micro-cavities in a gaseous medium was first considered by G. A. Askar'yan in 1962 [5]. He showed that the averaged force in the zone of boundary nonuniform field E_{avr} of an intensive pencil or focused beam, acting on electrons of an atom, i.e.,

$$F_{\text{avr}} = \frac{e^2}{m}\left\{\sum_k \frac{\omega_{0k}^2 - \omega^2}{(\omega_{0k}^2 - \omega^2) + \gamma_k^2}\right\}\nabla (E^2)_{\text{avr}}, \qquad (1)$$

where $\omega_{0,k}$ and γ_k denoted the resonant frequency and attenuation of the kth electron.

Due to this force, a difference in density of neutral molecules (for the beam axis) is formed:

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