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# Generation of Vacuum Tunnels into Atmosphere

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**Abstract**—It is proposed a method generation of vacuum tunnels (VT) into atmosphere by means of gradient force of laser fields. It is shown to build microscopic VT expulsive force of light beams (LB), located at Archimedes spiral in a region of narrow (~1 mm) coaxial layer at a boundary of VT and LB operation area, located at a circle, enveloping the light spiral, is sufficient. Average pulse power of LB is not greater than average power of gas-dynamic laser, based on rocket technology.

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## INTRODUCTION

Principle of operation of laser "lens", optical "tweezers", light "piston", atomic "mirror", and the other elements of laser optics of neutral particles are based on influence of gradient force of laser radiation influence [1–3]. Increase of ponderomotive action volume of gradient laser fields on gas molecules is essential stage of development of this field of application.

In this paper it is considered a problem of laser decrease of gas molecules concentration in VT volume to its viscosity elimination. VT generation rate and its dimensions must be enough great to provide dissipation-free motion of aircrafts with velocity about $10^3$–$10^4$ m/sec in case of minimal lasers power.

## 1. INTERRELATION OF GEOMETRICAL DIMENSIONS OF VT, ITS GENERATION RATE AND POWER

We divide mentally a volume of future cylinder VT onto $n$ coaxial layers of gas. Since these layers are located at different distances from VT boundary, then their extraction time from VT depends on layer radius $r_i$, where $i = 1, 2, 3, \ldots, n$. Let VT boundary is located at a distance $r_m$ of VT axis. Then external radius of $i$th layer is $r_i = ir_m / n$. Distance $\Delta r_i$, which $i$th layer passes to VT limit $r_m$, is

$$\Delta r_i = r_m(1+1/n) - \frac{ir_m}{n} = \frac{r_m}{n}(n+1-i). \tag{1}$$

A mass of $i$th layer in case of equal thicknesses of coaxial layers is

$$m_i = \frac{\pi\rho L r_m^2}{n^2}(2i-1). \tag{2}$$

If radial velocity of gradient drift of all particles is equal to $v_r$, then extraction time of $i$th layer is

$$t_i = \frac{\Delta r_i}{v_r} = \frac{r_m}{v_r n}(n+1-i). \tag{3}$$

Modification of kinetic energy of all molecules of $i$th layer is $\Delta E_i = m_i v_r^2 / 2$ and power, required for $i$th layer extraction is $P_i = m_i v_r^2 / 2t_i$. Substituting instead of $m_i$ and $t_i$ their expressions (2) and (3), and summing up by all layers, we obtain total power: