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# Electromagnetic Radiation can affect the Lift Force

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Here we show that, under certain circumstances, electromagnetic radiations can strongly reduce the lift force. An aircraft for example, can be shot down when reached by a flux of specific electromagnetic radiation. This discovery can help the aircraft pilots to avoid regions where there are electromagnetic radiations potentially dangerous. Not only the flight of the aircrafts are affected by the electromagnetic radiation, but also the flight of any flying object whose flight depends on the lift force, including birds and flying insects.

**Key words:** Lift Force, Aircrafts, Gravitational Mass, Microwave Radiation.

The expression of the lift force (L) is given by [1]

$$L = C_L \left( \frac{1}{2} \rho v^2 \right) A \quad (1)$$

where  $C_L$  is the lift coefficient,  $\rho$  is air density,  $v$  is true airspeed,  $A$  is the wing area. Equation (1) is derived from the Bernoulli equation

$$\frac{1}{2} \rho v^2 + \rho gh + P = C \quad (2)$$

which is obtained starting from the variations of the potential energy ( $mgh$ ), and kinetic energy ( $\frac{1}{2}mv^2$ ); the mass  $m$  is expressed by means of the following equation:  $m = \rho Av \Delta t = \rho V$ , ( $V$  is refers to the volume).

The quantization of gravity [2] showed that the *gravitational mass*  $m_g$  and *rest inertial mass*  $m_{i0}$  are not equivalent, but correlated by means of a factor  $\chi$ , which can be reduced and made negative, for example by means of absorption or emission of electromagnetic radiation. Only for  $\chi = 1$ ,  $m_g = m_{i0}$ . The correlation is expressed by means of the following equation

$$m_g = \chi m_{i0} \quad (3)$$

In addition, it was shown [2] that the new expressions for the kinetic energy and potential energy are respectively, given by

$$\frac{1}{2} m_g v^2 \quad m_g gh \quad (4)$$

Consequently the variable  $\rho = m/V$ , in the Eqs. (1) and (2) must be replaced by  $\rho_g = m_g/V = \chi m_{i0}/V = \chi \rho_{i0}$ . Thus, the Eq. (1) will be rewritten as follows

$$L = C_L \left( \frac{1}{2} \rho_g v^2 \right) A = C_L \left( \frac{1}{2} \chi \rho_{i0} v^2 \right) A \quad (5)$$

This is the generalized expression for the lift force (See Fig. 1).

The atmospheric air contains water droplets. Thus, if a region of the Earth's atmosphere is subjected to *electromagnetic radiation* then, according to Eq. (3), the gravitational mass of the water droplets in this region will be reduced. In this particular case, the gravitational mass of the water droplets (*gravitational mass of water droplets cloud* (WDC)) will be reduced according to the following expression [3]:

$$\chi = \frac{m_{g(wdc)}}{m_{i0(wdc)}} = \left\{ 1 - 2 \left[ \sqrt{1 + \frac{n_r^2 n^6 S_\alpha^2 S_m^4 \phi_m^4 D^2}{\rho^2 c^4 f^2}} - 1 \right] \right\} \quad (6)$$

where  $f$  and  $D$  are respectively the frequency and the power density of the electromagnetic radiation;  $\phi_m$  is the average "diameter" of the molecules of water,  $S_m = \frac{1}{4} \pi \phi_m^2$  is the cross section area;  $\rho$  is the density of the *water droplets cloud* inside the air;  $S_\alpha$  is the *maximum area* of the cross-section of the *water droplets cloud* (perpendicular to the incident radiation);  $n_r$  is the *index of refraction* of the water droplets cloud, and  $n$  is the number of molecules per unit of volume in the water droplets cloud, which is given by the following expression  $n = \sqrt{n_{(water)} n_{(air)}}$ , where  $n_{(water)}$  and  $n_{(air)}$  are calculated by means of the following equation:

$$n = \frac{N_0 \rho_m}{A} \quad (7)$$

where  $N_0 = 6.02 \times 10^{26}$  *molecules/kmole* is the Avogadro's number;  $\rho_m$  is the matter density

(in  $kg.m^{-3}$ ) and  $A$  is the molar mass of the molecules (in  $kg.kmol^{-1}$ ). Since  $\rho_{water}=10^3 kgm^{-3}$ ,  $A_{water}=18kg.kmol^{-1}$ ,  $\rho_{air}=0.4kg.m^{-3}$  (9-10km height<sup>\*</sup>),  $A_{air}=14kg.kmol^{-1}$ , then we get  $n_{(water)}=3.3 \times 10^{28} molecules / m^3$  and  $n_{(air)}=1.7 \times 10^{25} molecules / m^3$ . Considering that in the atmospheric air 40% is water droplets and 60% air, then for water droplets cloud, we can write that

$$n = \frac{0.4n_{(water)} + 0.6n_{(air)}}{2} \cong 6.6 \times 10^{27} molecules / m^3$$

By reducing the gravitational mass of the water droplets cloud inside the air, it is possible reduce the gravitational mass of the air,  $m_{g(air)}$  and, consequently, to reduce the air density  $\rho_g = m_{g(air)}/V = \chi m_{i0(air)}/V = \chi \rho_{i0(air)}$ . According to Eq. (5), this affects the intensity of the lift force.

In order to evaluate how much the lift force can be affected, we will start from Eq. (6). By substituting the values:  $n_r \cong n_{r(water)} \cong 1.33$ ;  $\rho \cong \rho_{air} \cong 0.4kg.m^{-3}$  (9-10km height);  $n = 6.6 \times 10^{27} molecules / m^3$ ,  $\phi_m = 1.55 \times 10^{-10}m$ ,  $S_m = 1.88 \times 10^{-20}m^2$ , and  $c$  (speed of light) into Eq. (6), we get

$$\chi = \frac{m_{g(wdc)}}{m_{i0(wdc)}} = \left\{ 1 - 2 \left[ \sqrt{1 + 8.1 \times 10^{15} \frac{S_\alpha^2 D^2}{f^2}} - 1 \right] \right\} \quad (8)$$

Masers with the  $f = 1.4GHz$  and  $D_0 \cong 10^4 W / m^2$  already can be produced [4]. Assuming that the divergence angle of the maser beam is  $\alpha \cong 0.1^\circ$ <sup>†</sup>, then a laser beam with initial 3.7cm diameter will have at 10km height 35m diameter, which gives  $S_\alpha = \pi(35)^2/4 = 9621m^2$ .

The power density in the area  $S_\alpha$  is

$$D_\alpha = \eta(\phi_0/\phi_\alpha)^2 D_0 =$$

$$= 0.9(0.037m/35m)^2 10^4 W / m^2 = 0.01W / m^2.$$

where  $\eta$  is the absorption factor. Substitution of

the values of  $S_\alpha = 962.1m^2$ ,  $D = D_\alpha = 0.01W / m^2$  and  $f = 1.4GHz$  into Eq. (8) yields

$$\chi = \frac{m_{g(wdc)}}{m_{i0(wdc)}} = 0.65 \quad (9)$$

Under these conditions, the density  $\rho_g$ , and also the lift force  $L$ , is reduced about 35%. Note that for  $D = D_\alpha > 0.019W / m^2$ , the value of  $\chi$  becomes negative. In this case, the lift force also becomes negative (See Eq. (5)), shooting down the aircraft. Note that, if a radiation with these characteristics hits totally an airstrip, then none aircraft will able take-off from this airstrip, because the negative lift force makes impossible the take-off.

Let us now consider, for example, a room with volume  $V = 3 \times 3 \times 3 = 27m^3$ , ( $S_\alpha = 9m^2$ ), where the air inside is subjected to an electromagnetic radiation with frequency  $f = 1.4GHz$ . Since the air density is  $\rho_{air} = 1.2kgm^{-3}$ , then we get:

$n_{(air)} = 6.8 \times 10^{25} molecules / m^3$ . However, the value of  $n$  remains approximately the same, i.e.,  $n \cong 6.6 \times 10^{27} molecules / m^3$ . Then, assuming  $\rho \cong \rho_{air} \cong 1.2kg.m^{-3}$ , Eq. (6) gives

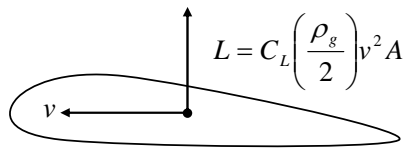
$$\chi = \frac{m_{g(wdc)}}{m_{i0(wdc)}} = \left\{ 1 - 2 \left[ \sqrt{1 + 9.0 \times 10^{14} \frac{S_\alpha^2 D^2}{f^2}} - 1 \right] \right\} \\ = \left\{ 1 - 2 \left[ \sqrt{1 + 0.037D^2} - 1 \right] \right\} \quad (10)$$

This equation shows that for  $\chi = 0.65$  the power density must be  $D = D_\alpha = 3.2W / m^2$ . Here, the value of  $\chi$  becomes negative when  $D = D_\alpha > 5.82W / m^2$ <sup>‡</sup>. In this case, any flying insect that penetrates the mentioned room, will be shot down. This can be very useful in the combat to the mosquitoes, which are responsible by the transmission of several diseases.

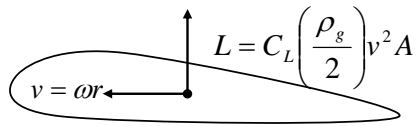
\* Usual height for most aircraft flights.

† Most of laser beams has  $1.26mrad < \alpha < 6.3mrad$ ; then  $\bar{\alpha} = \sqrt{1.26mrad \cdot 6.3mrad} \cong 2.8mrad \cong 0.1^\circ$  [5].

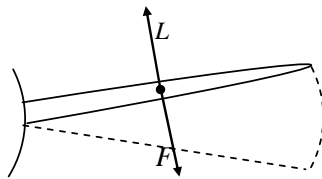
‡ Maximum output from a GSM850/900 mobile phone is ~2W. Thus, the power density near the head (~5cm) is greater than 60W/m<sup>2</sup>. At 1m distance from the phone is about 0.15W/m<sup>2</sup>, and at 0.22m distance the power density is 3.2W/m<sup>2</sup>.



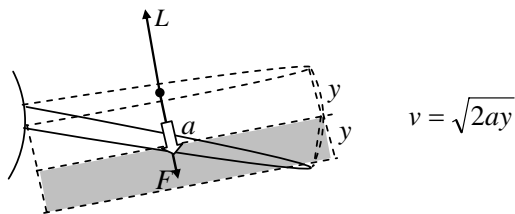
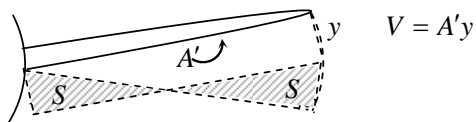
Aircraft wings



Helicopter helices



Wings of birds, mosquitoes, etc.



The wings push the air with a force  $F$ , and it reacts with a force  $L = F$ . Then,

$$\begin{aligned}
 L = F &= m_g a = \left( \frac{m_g}{V} \right) V a = \rho_g (A' y) a = \rho_g A' (a y) = \\
 &= \rho_g A' \left( \frac{v^2}{2} \right) = && \text{(Since } v = \sqrt{2ay} \text{ )} \\
 &= \rho_g (C_F A) \left( \frac{v^2}{2} \right) && \text{(Since } A' = C_F A \text{ )} \\
 \mathbf{L} &= \mathbf{C_F} \left( \frac{\rho_g}{2} \right) \mathbf{v^2 A}
 \end{aligned}$$

Fig. 1 – The Lift Force

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