

Influence of a field-less electrostatic potential on the inertial electron mass

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ABSTRACT. The experiment herewith described confirms the effect obtained by us earlier [1]: the effective electron's mass is changed when it is placed anywhere inside a charged spherical shell at a constant and uniform Coulomb potential, V .

1 Introduction

The purpose of this experiment is to check the consequence which follows from Weber's electrodynamics: a dependence of the effective inertial mass of a charged particle on the electric potential existing at the location of the charge, [2-10].

By Assis, [2], the effective inertial mass m of such particle when it is placed inside a charged spherical shell at constant and uniform Coulomb potential V (choosing the value zero at infinity), is:

$$m = m_0 \left[1 - \frac{qV}{3m_0c^2} \right] \quad (1)$$

where:

$$m_w = \frac{qV}{3c^2} \quad (2)$$

is Weber's mass, c is light velocity in vacuum, m_0 is the rest mass of the test particle and q its charge.

Formula (1) may be tested experimentally. Obviously, the most suitable particle for this purpose will be the lightest charged particle – the electron. In this case the effect may be observed even for potentials V which are not so high. When $q = e$ (charge of electron):

$$\frac{m_w}{m_0} = \frac{eV}{3m_0c^2} \quad (3)$$

Let $eV = 3\text{keV}$ and $m_0c^2 = 511\text{keV}$.

Then
$$\frac{m_w}{m_0} = 2.10^{-3}$$

This quantity may be measured experimentally. For the experimental test we shall pay attention to the important properties of expression (1):

1. Weber's mass depends linearly on the potential of the sphere;
2. When $qV > 0$, $m < m_0$;
3. When $qV < 0$, $m > m_0$. (*)

The basis of the present experiment is the idea realized in our first work, [1]. We measure the oscillation frequency of a neon glow lamp RC-oscillator placed inside the spherical shell. This frequency, other conditions being equal, depends on the electric current in the glow discharge, which depends on the mass of the charge carriers. Thus the change in the electron's mass causes a change in the frequency of oscillations.

Investigation of the generator circuit, Fig.1, results in a simple correlation between the period of the oscillations, T , and the effective electron's mass, m . As a first approximation:

$$T = km \quad (4)$$

where k is some constant.

Thus:

$$\Delta T = k\Delta m = km_w \quad (5)$$

or
$$\Delta T/T_0 = m_w/m_0, \tag{6}$$

where T_0 is the period of oscillations when $V=0$; $\Delta T=T-T_0$ (T being the period when $V \neq 0$).

2 Experiment.

In the first experiment it was utilized only one spherical shell, [1]. In the present experiment two concentric spherical shells are utilized. The first, internal screen, is constantly connected to the circuit of the generator. The second, external screen, is constantly connected to a source of a high voltage which may be changed at will. Moreover, the internal screen may be connected either to the earth, or to the source of high voltage by the switch SW, Fig. 1.

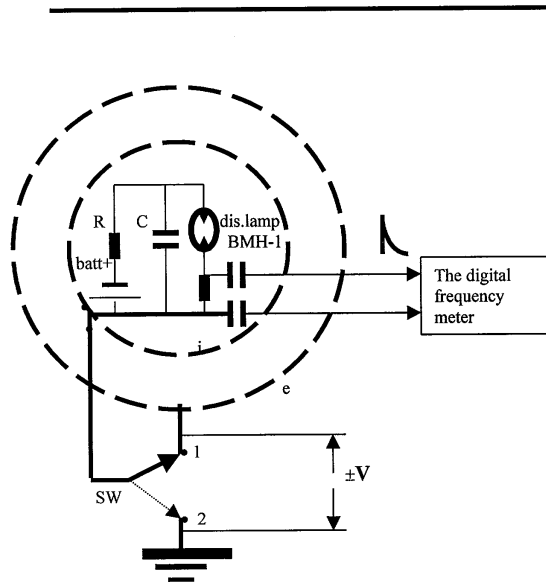


Figure.1 Scheme of the experimental set up: (i) is the internal spherical electrostatic screen; (e) is the external spherical screen. The screen (i) is connected with the negative side of the power supply (battery) of the RC-generator. SW is the switch of a high potential V. The oscillator frequency is $f_0=124$ Hz (when $V=0$).

Thus, there are two variations of supervision of the effect:
 The generator and the internal screen are connected to the external sphere;

The generator and the internal screen are connected to the earth.

Results of the measurements that have been carried out in these two variations are presented in Fig.2.

Variation 1 (the line $\bullet-\bullet$) gives the results coinciding with the results of the first experiment [1].

Variation 2 (the line $*-*$) gives effect of the same magnitude, but in this case the effect has opposite sign (inversion of a sign of effect). Switching SW from position 1 to position 2 ($V = \text{constant}$) results in the transition specified on Fig.2 by an arrow (and vice versa).

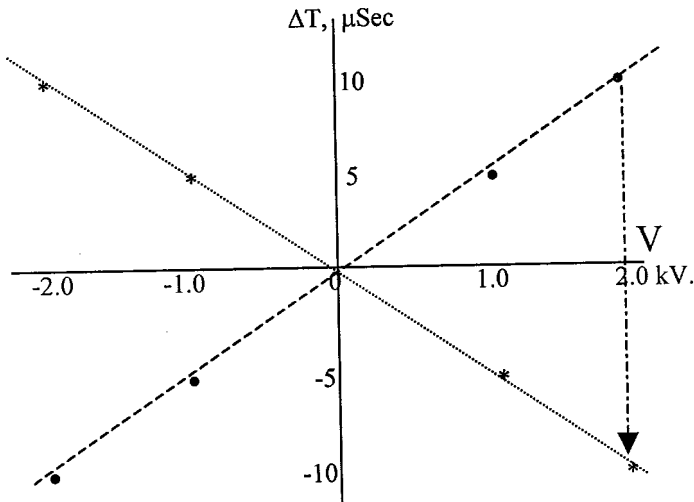


Figure.2 Plot of ΔT as a function of V . Points are the experimental ones. Position of switch is: \bullet - 1; $*$ - 2.

The magnitude of the effect observed in this experiment is the same as in first work [1]. The period of oscillation T was determined as an average from the transmission time, t , of a series of N pulses of the generator: $T=t/N$. In this case $N=10000$. The error of the frequency meter is equal to 0.0001 sec.

3 Discussion.

The first variation of supervision of the effect coincides with our first experiment [1]. All conditions that follow from Assis' theory take place here:

the potential of the generator is equal to potential of the screen and inside the screen the electric field due to the spherical shell is equal to zero.

Measurements with this device confirmed completely the prediction of the theory both for the magnitude and for the properties of the effect mentioned above in (*).

The second variation of the experiment demands a more detailed discussion. In this case the magnitude of effect also coincides with the theory, however the sign of the effect is, at first sight, contrary to what should be expected. However, this contradiction is only apparent. Internal and external screens form a spherical capacitor. As is well known, the configuration of the electric field between the two shells of the spherical capacitor is identical to the field of a point charge (inverse-square law) and does not depend on the radii of the spheres: we may imagine a design with the external spherical shell having a large radius. If $R \rightarrow \infty$ Such design will be completely equivalent to previous experiment with only one spherical screen, [1]. If the sign of the potential of this screen is changed, there is an inversion of sign for the measured effect.

The legitimacy of such a substitution is based on the fact, that the sign of the potential of the screen of the generator and the direction of its external electric field (in this case it is the electric field between the two shells of the spherical capacitor) have rigid correlation: for example, if the field is directed from a surface to infinity, the potential of this surface is positive (and vice versa). Such explanation seems to us simple and logical.

4 Conclusion.

The electrostatic contribution to the effective electron's mass has been confirmed. The magnitude (within the measurement errors) and sign of the effect coincide with those predicted by Assis' theory.

5 References.

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