Addendum to “COULOMB INTERACTION DOES NOT SPREAD INSTANTANEOUSLY”

Rumen I. Tsontchev, Andrew E. Chubykalo and Juan M. Rivera-Juárez
Escuela de Física, Universidad Autónoma de Zacatecas
Apartado Postal 5-580 Zacatecas 98068, Zac., México
e-mails: rumen@ahobon.reduaz.mx and andrew@ahobon.reduaz.mx

Received 2001

Abstract

We describe the results of experimental research by configurations changed with respect to the original experimental configuration [1]. In this way it is demonstrated that the basic part of the signal registered is due to the Coulomb electric field and does not originate from the transversal electromagnetic wave.

PACS: 03.50.-z, 03.50.De
The basic doubt regarding the reliability of our results is due to the fact that it is not known which part of the signal obtained by us is due to the Coulomb interaction, and which part is due to the presence of a regular transversal electromagnetic wave. The theoretical consideration is difficult because of the complexity of the experimental construction.

For this reason, it is more appropriate to determine this by means of experiment.

In our Coulomb electric field generator (Fig. 1) there are three elements which emit transversal electromagnetic waves:

1. the currents which flow along the surface of the spheres of the Van de Graaf generators
2. the spark, which jumps between the electrodes of the discharger
3. the currents which flow along the discharge cable
During our experiments, the discharge cable was electrically and magnetically shielded. For its construction, the discharge cable was heavy coaxial cable. The discharge current flowed along the central conductor. As an electric shield, its shield with a thickness of approximately 1 mm was used, which is much greater than the depth of the skin layer (0.03 mm) for the resonant frequency of 14 MHz. For the magnetic shield, a 5 mm thick iron sectioned tube was used. The coaxial cable was placed inside the iron tube without electric connection between them. The discharger was not shielded. The shielding of the spheres of the Van de Graaf generators is not recommended as the signal due to the Coulomb electric field would be lost.

Consequently, it is necessary to evaluate the contribution of the transversal electromagnetic waves emitted both by the discharger and by the Van de Graaf generator’s spheres. In practice, it is only necessary to consider the influence of the active Van de Graaf generator as the passive generator is considerably further away from the antenna 2. For this reason, the signal originating from the passive Van de Graaf generator reaches antenna 2 (the measuring antenna) with a delay greater than 60 ns. That is, the said signal reaches antenna 2 after measuring and does not influence the experimental result.

The general idea of the proposed experiments is simple. If the initial direction of the currents that flow through the discharger and along the sphere’s surface changes, then the sign of the first front of the electromagnetic wave emitted by them must change. Consequently, if the predominant part of the signal is due to the electromagnetic wave, the sign of the first flank of the signal obtained by the antennas will change. The amplitude will change simultaneously.
With this purpose, an orifice will be perforated in the head of the active Van de Graaf generator. A thick ceramic wall tube, which does not allow electric rupture up to a voltage of 150 kV (Fig.2), is placed in the orifice.

FIG. 2. Modified head of the Van de Graaf active generator.

A conductor, which is connected electrically to the other pole of the sphere, is placed along the axis of the tube. As we will demonstrate further on, a construction of this type allows for a reversal of the currents along the surface of the sphere. It is important to point out that the electromagnetic wave emitted from the current, which passes through the central conductor, is isolated from the metallic walls of the sphere.

Experiments have been carried out with four configurations. In fig.1 we show a regular configuration; in figures 3, 4 and 5, the configurations are modified. The direction of the initial movement of the electrons is indicated by arrows in all of the figures.
FIG. 3. Inverse direction configuration of the electric current which passes along the surface of the head of the Van de Graaf active generator.

FIG. 4. Inverse direction configuration of the electric current which passes through the discharger.
FIG. 5. Inverse direction configuration of the electric current which passe through the discharger and along the surface of the head of the Van de Graaf active generator.

Each configuration has been investigated in three regimes:

a. the discharge cable is not shielded.

b. the discharge cable is a coaxial cable. The discharge current passes through the central thread. The cable shield is not connected to earth.

c. as in b., but the shield is connected to earth.

In this way we can evaluate the influence of the discharge cable screen on the processes. As we can see from the figures, the general flow of the electrons is always in the same direction - from the passive Van de Graaf generator towards the active Van de Graaf generator. Because of this, the
signal due to the Coulomb electric field in the case of the four configurations does not undergo significant changes. Consequently, if the basic part of the signal is due to the Coulomb interaction, we should observe, in the case of the four configurations, an impulse with negative first flank (Fig.6).

FIG. 6. Real form of the signal obtained by all of the configurations.

At the same time, in two configurations the direction of the current in the discharger changes in the opposite way (Fig.4, Fig.5). In an analogous manner, the direction of the currents which flow along the surface of the sphere changes in two configurations (Fig.3, Fig.5). Consequently, if our signal is due to the electromagnetic waves emitted, or to the discharger, or the sphere, or both together, at least in one configuration we should observe a change in the sign of the first flank on the oscilloscope screen (Fig. 7).
FIG. 7. Supposed form of the signal generated from the transversal electromagnetic wave by changed configuration.

As the experiments are carried out we can see that ALWAYS, regardless of the configuration and measurement regime, an impulse as pointed out in Fig.6 is obtained.

The proportion between the signal amplitudes, obtained in the configurations presented in figures 3, 4 and 5, taking the signal amplitude of the regular configuration as reference point (Fig. 1), has been investigated. The result is that the relative deviation of the amplitudes does not exceed 5%.

Consequently, we can arrive at the definite conclusion that the dominant part of our signal is due to the Coulomb interaction. Consequently, if the Coulomb interaction is propagated instantaneously, we should record this fact. However, in reality we only record the propagation of a wave. In this manner, we can consider that it has been demonstrated experimentally that the Coulomb electric field is propagated like a Coulomb wave (i.e. not instantaneously).
REFERENCES

[1] R.I. Tzonchev, A.E. Chubykalo and J.M. Riviera-Juárez, Hadronic Journal 23, p. 401-424 (2000).
This figure "Figgg1.jpg" is available in "jpg" format from:

http://arxiv.org/ps/physics/0104014v1
This figure "Figg2.jpg" is available in "jpg" format from:

http://arxiv.org/ps/physics/0104014v1
This figure "Figgg3.jpg" is available in "jpg" format from:

http://arxiv.org/ps/physics/0104014v1
This figure "Figgg4.jpg" is available in "jpg" format from:

http://arxiv.org/ps/physics/0104014v1
This figure "Figgg5.jpg" is available in "jpg" format from:

http://arxiv.org/ps/physics/0104014v1
This figure "Figgg6.jpg" is available in "jpg" format from:

http://arxiv.org/ps/physics/0104014v1
This figure "Figgg7.jpg" is available in "jpg" format from:

http://arxiv.org/ps/physics/0104014v1