Ralph Malcolm Rabbidge on Gauss' Law

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1 Introduction

Ralph Malcolm Rabbidge, who is posting in the usenet-group sci.physics.relativity under the pseudonym Henry Wilson, has made some remarkable claims about the application of Gauss' law. We will show that the claims are wrong.

2 Gauss' Law

"The total of the electric flux out of a closed surface is equal to the charge enclosed divided by the permittivity".

$$\Phi = \frac{Q}{\epsilon_0} \tag{1}$$

$$\Phi = \oiint_S \vec{E} \cdot \mathrm{d}\vec{A} \tag{2}$$

where:

- $\boldsymbol{S}$ is the closed surface
- $\boldsymbol{\Phi}$ is the electric flux out of S
- $\boldsymbol{Q}$ is the the charge enclosed by S
- $\boldsymbol{\epsilon_0}$ is permittivity of vacuum
- $\boldsymbol{\vec{E}}$ is the electric field from Q
- $\mathbf{d}\boldsymbol{\vec{A}}$ is a vector perpendicular to S representing an infinitesimal element of area

3 Example of application of Gauss' law

Given a positively charged hollow metallic sphere surrounded by some charged metallic balls. The sphere and the balls are kept in fixed positions by non conducting supports.

The problem is: *What is the electric field inside the hollow sphere?*

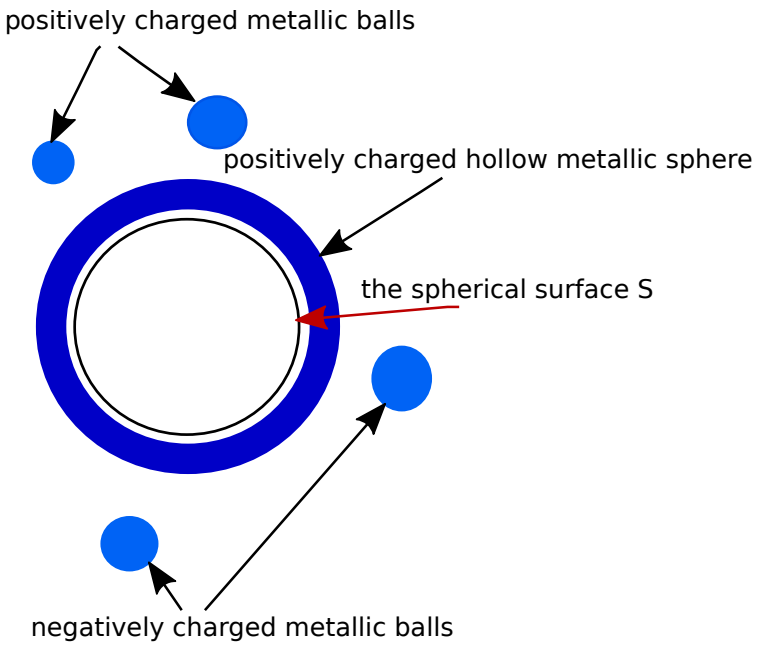

Figure 1: *Hollow metallic sphere surrounded by charged metallic balls*

4 Ralph Malcolm Rabbidge's solution

On 26.10.2015 Ralph Malcolm Rabbidge wrote in the usenet group sci.physics.relativity:

> *"The force due to a charge on the outside surface of a hollow conducting sphere still acts on every charge INSIDE that sphere. Gauss's law is derived from the integration of all forces due to all the charges on the outside surface. The resultant is always zero at any point."*

On 01.11.2015 Ralph Malcolm Rabbidge wrote in the usenet group sci.physics.relativity:

> *"..and as I pointed out in the case of a charged metal spherical shell, the fact that there is no field inside is quite compatible with the theory that the forces exerted by the charges DO pass through the shell. The integral shows that the resultant force inside is always zero."*

It is not clear which forces Ralph Malcolm Rabbidge is talking about. Forces on what inside the empty hollow sphere? However, it is trivial knowledge that there is no electric field inside the hollow sphere, so this is what he must be referring to. And neither is it clear which integral he is referring to. What integral is it that includes the charges on the *outside* of the hollow sphere and give the field on the *inside*?

It is indeed a weird idea that "the forces exerted by the charges DO pass through the shell". If they do, why is then the electric field inside the sphere zero when the charges on the outside of the shell are not symmetric?

5 The correct solution

The correct solution is quite trivial. There is no charge inside the spherical surface S (see Fig. 1), so equation (1) becomes:

$$\Phi = \frac{0}{\epsilon_0} = 0 \tag{3}$$

and equation (2) becomes:

$$\oiint_S \vec{E} \cdot \mathrm{d}\vec{A} = 0 \tag{4}$$

which has only one solution, $\vec{E} = 0$ everywhere inside the hollow sphere. It is utterly irrelevant which charges there are on the outside of the hollow sphere, because these charges do no contribute in any way to the integral giving the field inside the sphere.

6 Conclusion

Ralph Malcolm Rabbidge's claims quoted above are utter nonsense.
They reveal a remarkable ignorance of elementary electrostatics.