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Earnshaw's Theorem and Magnetic Levitation

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Abstract. It is suggested that much confusion has been caused in modern physics by failure to distinguish different coordinate frame origins within different equations.

The Magnetic Force

I. The solution for the **B** vector in Maxwell's equations is $\mathbf{B} = (1/c^2)\mathbf{v}X\mathbf{E}$. It differentiates under the curl operator to yield Ampère's circuital law precisely. See section **VII** of 'The Unification of Gravity and Magnetism' at,

http://www.wbabin.net/science/tombe15.pdf

The inverse square law inherent in the Biot-Savart law is by virtue of the Coulomb force solution to the **E** vector, and based on the inverse square law of the Coulomb force, it is traditionally assumed that the inverse square law can be extrapolated throughout electromagnetic forces generally.

We are overlooking two very important factors. The first of these factors concerns the origin of the coordinate frame of reference. Traditionally we link the origin of the coordinate frame in the Biot-Savart law to the electric circuit that generates the magnetic field. However, we cannot do this in the case of a **B** vector that is deep in space and that is linked to electromagnetic radiation. In such a case we are left with no choice but to centre the coordinate frame on an individual rotating electron positron vortex. It would therefore follow that perhaps we ought to be doing this in every situation, and that the inverse square law in electromagnetism is something that only occurs on the microscopic scale. We have got absolutely no basis whatsoever to assume that the inverse square law continues to hold on the large scale when we sum over the entire sea of electron positron vortices.

The other factor that we are overlooking is the solenoidal nature of magnetic field lines. As magnetic field lines emerge from the end of a bar magnet, they diverge. The field lines at the intersection will trace out distinct solenoidal paths in space. Beyond the field lines at the intersection, the magnetic field associated with this particular bar magnet will come to an abrupt end. Such a picture does not tie in with an inverse square law relationship for magnetic force.

There is good reason also to suspect that even electrostatic force on the large scale does not obey an inverse square law. See 'Gravity Reversal and Atomic Bonding' regarding centrifugal force on the microscopic scale and reversal thresholds at,

http://www.wbabin.net/science/tombe6.pdf

Earnshaw's Theorem

II. Earnshaw's Theorem [1] is based on Gauss's law and it tells us that we can never obtain a stable array of particles in static equilibrium where only inverse square laws of force are involved. It is commonly believed that Earnshaw's Theorem forbids both magnetic and electrostatic levitation since gravity, electrostatics, and magnetism are all believed to obey the inverse square law of force.

Yet we know that both magnetic and electrostatic levitation can be achieved providing a mechanism is put in place to confine all motion to the vertical plane. It occurs when we place ring magnets, like pole to like pole, over a wooden stick. It happens in the Levitron. In view of Earnshaw's Theorem we might be tempted to suggest that the fact of both magnetic and electrostatic levitation tends to add further proof to the idea that magnetism and electrostatics on the large scale do not obey the inverse square law contrary to popular belief.

However, the argument in section **I** above regarding coordinate frame origins can be carried to Earnshaw's Theorem itself. There is no basis whatsoever to assume that Earnshaw's Theorem applies in situations were two inverse square law forces are centred on different coordinate frame origins.

Let's suppose for the sake of argument that the magnetic force of repulsion does obey an inverse square law force. In the case of ring magnets placed over a wooden stick, the coordinate frame origin will be somewhere near the base of the apparatus. In the case of the gravitational force of attraction however, the coordinate frame origin is at the centre of the Earth. [2]

If the force with the lesser numerator also has a later origin then it can overtake the other force as they both tend towards zero. If the numerator of the magnetic force is less than the numerator of the gravitational force, then the different origins for the two graphs will mean that they can intersect and create a stability node. In other words, magnetic levitation by no means has to contradict Earnshaw's Theorem. For the same reasons, neither would constrained electrostatic levitation defy Earnshaw's Theorem.

Conclusion

III. If large scale magnetic or electrostatic force does not obey the inverse square law, Earnshaw's Theorem will not be defied in cases of magnetic or electrostatic levitation. But even if they do obey the inverse square law, Earnshaw's Theorem is still not defied for the very same reason as one of the reasons for suspecting that magnetic force does not obey the inverse square law on the large scale.

References

[1] Earnshaw, S. On the nature of the molecular forces which regulate the constitution of the luminiferous ether. Trans. Camb. Phil. Soc., 7, pp 97-112, 1842

[2] Ian Montgomery in Australia who is currently working on an electron positron couplet theory to explain electromagnetism has also suggested that two separate coordinate frame origins is probably the key to the mystery of magnetic levitation.