C2N Seminar

Friday December 10th - 10h00

"D and H cannot exist: Axion bombs, Black holes and breaking global charge conservation."

Lien zoom: https://us02web.zoom.us/j/86277738532

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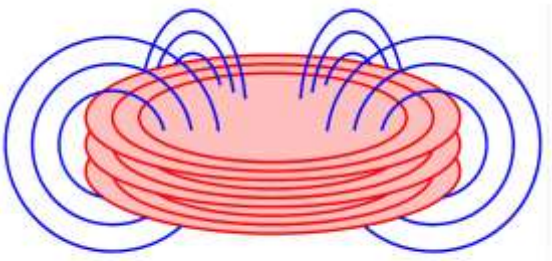
Charge conservation is a fundamental, and experimentally verified rule of electrodynamics. It turns out that only local charge conservation is needed and attested. Going from local charge conservation to global charge conservation requires either one of two assumptions, or both. Either the excitation fields D and H are well defined or spacetime has no holes. We can therefore break global charge conservation by both demanding spacetime has a hole and D and H are not defined. We can provide the spacetime hole by creating a black hole that evaporates.



Arrangement of electromagnetic (blue) and axion (light red) fields to be cast into a black hole to break global charge conservation.

Since D and H cannot be directly measured, they have a gauge freedom [1]. Admitting this freedom opens many possibilities, concerning axions, which have direct application. We show a simple scenario using wires and voltmeters which due to topological reasons is impossible using D and H [2]

We have given an explicit solution to these modified Maxwell equations in a simplified holey spacetime namely Minkowski spacetime with a point removed. The solution can be given pictorially. See Figure: Blue electromagnet fields, light red axion field, dark red axion sources [3,4,5].

[1] J. Gratus, P. Kinsler, M. McCall, (GKM), Euro. J. Phys. 40, 2, (2019)
[2] GKM PRA 101, 4, (2020)
[3] GKM Found. Phys. 49, 4, p. 330-350. (2019)
[4] GKM Annalen der Physik. 533, 6, (2021)
[5] Netherlands New Scientist article.
https://www.newscientist.nl/nieuws/kun-je-een-natuurwet-breken-met-een-axionenbom-en-een-zwart-gat/

Jonathan Gratus is a senior lecturer in mathematical physics and a member of the Cockcroft Institute of Accelerator Science. He is interested in geometric methods of understanding electrodynamics. He has a board range of interests including spacial dispersion, homogenisation, waveguides, radiation reaction, distributions, general relativity, and Particle-In-Cell codes.