A Test for Space-Time Entropic Flow

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Abstract

A basic experiment is proposed to test the conjecture of space-time flow.

S. Liberati and L. Maccione are perhaps the most recent to have explored the possibility of space-time flow. [1] They have proposed investigating the viscosity of the supposed space-time flow to determine its existence.[1]

A somewhat different and perhaps simpler experiment, based on the following analysis, is proposed here.

If space-time is granular then to preserve the isotropy required by special relativity [2] it would seem the granules of space-time may not be in some static anisotropic lattice form but must be in an entropic state, deforming rapidly and randomly. From this it may be possible to infer, from basic Thermodynamics, an entropic flow of these granules moving from isotropic to anisotropic regions of space-time. [3] Indeed if such a space-time manifold can be considered fundamentally smooth it is already equipped with conservation of isotropy and isotropic flow. [4]

A fairly straight forward experiment to test this reasoning would be to perform idealized Davisson-Germer [5] where (1) the apparatus is contained in a small volume appropriately shielded from any external entropic flow, and (2) the entry point of the electron beam and the recording plate are equidistant from the double slits.

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[1] This position may be something of a straw man, since from the analysis that follows the viscosity of space-time may be already evidenced in the constancy of *c*. The analysis will posit a Wheeler-like space-time foam where the granules of space-time are in a continuous state of random deformation. Then as a photon moves through, each granule must readjust from random deformation to the periodic fluctuation of the photon in time δt which allows for passage no more rapidly than $\frac{\lambda}{\delta t}$ = *c* (with λ as Planck length).

Under those conditions the entropic flow suggested will be verified if there is no electron interference, and *per contra* if there is. To see this we examine the slit screen experiment from the point of view of this entropic flow: first where conditions (1) and (2) do not hold (as has routinely been the case), and, secondly, where they do.

Consider the slit screen apparatus *before* an electron is shot through.

Without conditions (1) and (2) the volume of space behind the electron source (the lab space) will be much greater than that between slit screen and detector. As a result the entropic pressure entering the apparatus will be much greater than the pressure exiting.

Thus although the entering granule rays will not be totally blocked at the screen by those exiting, they will be scattered, a scattering marked by the limitation that adjoining granule rays (except at the apex of the scattering) can be no closer together than the radius of a single granule, a limitation which implies that the scattering cannot be everywhere dense, that there will be areas on the detector screen inaccessible to the incoming rays.

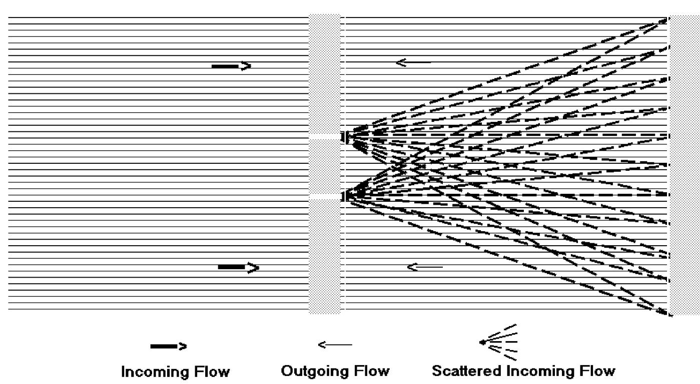

FIGURE 1

Figure 1 shows, in horizontal hash lines, a suggestion of the exiting entropic rays, and, in angled lines, a suggestion of the entering entropic rays. The diagram can only be suggestive since with the slits approximately 1 mm wide and the granules of each entropic ray of approximate Planck diameter, i.e., 10^{-33} cm, there would be approximately 10^{30} rays entering each slit.

Now consider what this flow implies when we send electrons, even one at a time, into the apparatus. Will they follow the space-time flow? That would obviously depend on the pressure exerted by the flow on an electron. For the limited purposes of the argument here we assume that an electron of radius c. 10^{-15} cm. and mass c. 9.1×10^{-31} kg. would be constrained to move with the flow.

What this implies, from the structure of the entropic flow, as illustrated in Figure1, is that the paradoxical "duality" concept[2] universally offered to explain the apparent interference effects in Davisson-Germer type experiments, could yield to the more intuitive notion of space-time entropic flow.

Of course all of the foregoing is simply speculation. Where we can put speculation to the test would be in the experiment proposed.

What the experiment would be designed to test would be, in the case where there is no resultant space-time flow into the Davisson-Germer apparatus (where the incoming and outgoing flows cancel), will we still find apparent electron interference?

If we do not find interference under these circumstances this would be strong verification of the entropic flow conjecture.

The design of such an experiment would not be a trivial undertaking. At a minimum it would require that the theoretical incoming and outgoing entropic flow pressure at the slits of the slit screen be precisely the same, and this, in turn, would appear to require (1) a shielding of the apparatus from any external entropic flow, and (2) a placement of the slit screen precisely midpoint of the electron gun barrel and the detector screen.

Whether such precision is even possible is something only an experimentalist can determine. And such determination, not to mention the cost of conducting the experiment itself, if thought possible, would be time-consuming and expensive.

Is it worth the time and expense?

A null result, awaiting more complex experimentation, would give us for now nothing more than we already know, and would serve as simply one more proof of the impregnability of Von Neumann's rejection of "hidden variables" and of Bohr's

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[2] While the wave/particle concept is itself troublesome it masks an issue that is even more so. If in its travels through the Davisson-Germer apparatus the electron is a "wave", not assuming back its particle status until being registered on the detector screen, and it is the interference of such waves that accounts for the pattern found on the detector, then the intensity of the electrons entering the apparatus, their number, should be reduced by the interference. But, experimentally, this does not appear to be the case.

Copenhagen interpretation.

Nor, it seems, would even a positive result necessitate any serious modifications of the formalisms which have served us so well coming on now to almost a century.

On the other hand, what we would gain from a positive result might be a deeper understanding of such matters as electron “interference,” the Aharonov-Bohm effect, and the deBroglie-Bohm pilot wave. And, it is also possible that the analysis leading to the conjectured space-time entropic flow could provide insights into the nature of “dark matter” (from the occasional mass-like anisotropic periodic pulsing of space-time granules in the sense of m = $\hbar\nu/c^2$), electron formation (from the miniscule but non-zero probability of adhesion of a number of such granules periodically pulsing in synchronicity), and an estimate of the volume of an electron (from the minimum number of such granules necessary to resist the random pulsing force of its neighbors).

REFERENCES

[1] S. Liberati, L. Maccione, “Astrophysical Constraints on Planck Scale Dissipative Phenomena,**”** *Phys.Rev.Lett.*, **112,** 151301 (2014). Consideration of space-time flow in one form or another has been around for a long time. Einstein alluded to it as early as 1920. A. Einstein, “Ether and the Theory of Relativity,” An Address delivered on May 5th, 1920, in the University of Leyden, reprinted in A. Einstein, *Sidelights on Relativity*, Dover, 1983, 1-24. Dirac and Infeld debated it in 1951-52. P.A.M. Dirac, Nature **168,** 906, Letters to the Editors, “Is there an Aether?” (1951); L. Infeld, Nature **169,** 702, Letters to the Editors, “Is there an Aether?” (1952). For an expanded critique of Dirac’s position see E.P.J. De Haas “A renewed theory of electrodynamics in the framework of a Dirac ether”, *Proc. P.I.R.T.-IX (London 2004)* PD Publications, Liverpool, pp 95-123 (2004). And, of course, John Wheeler proposed a similar concept as space-time “foam”. See Y.J.Ng, “Space-Time Foam,” arXiv:gr-qc/0201022, v.2 (2002).

[2] S. Liberati. “Tests of Lorentz invariance: a 2013 update**.”** *Classical and Quantum Gravity*, **30** (2013).

[3] Liberati & Maccione, *op.cit.supra*, for example, refer to the flow as a superfluid constrained perhaps by the classical equations of hydrodynamics.

[4] J.-P. Ortega and T. S. Ratiu, ”Symmetry and Symplectic Reduction”, arXiv:math.SG/0508634 v1 31 (2005).

[5] For the actual apparatus used *see*: C. Davisson, L.H. Germer, “Reflection of electrons by a crystal of nickel", Nature, **119,** 558–560 (1927).