Testing a Mechanism for Space-Time Flow

Jeffrey M. Albert
Boothbay Harbor, Maine

Abstract

An experiment is proposed to test a mechanism for space-time flow.

S. Liberati and L. Maccione are perhaps the most recent to have explored the possibility of space-time flow devoid of the characteristics of the "ether" rejected by Michelson-Morley but still retaining some measureable if small viscosity.[1]

The following conjectures a mechanism that might power such a flow. The conjecture has a substantial theoretical base, can be readily tested, and, if confirmed, carries significant implications.

We begin by suggesting that If space-time is granular (with granules presumably of radius ≤ Planck length)[2] then to preserve the isotropy required by special relativity[3] the space-time granules cannot be in 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/isotropic flow of these granules moving from isotropic to anisotropic regions of space-time.[4] Indeed since the manifold defined by this mechanism would be by definition experimentally "smooth"[5] it is already equipped, algebraically, with such a flow.[6]

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[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 many years. 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). 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] For an extensive review of the literature on discrete space-time see P.E. Gibbs, "The Small Scale Structure of Space-Time: A Bibliographical Review " arXiv:hep-th/9506171v2 (1996).

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

[4] Liberati & Maccione consider the flow to be analogous to a superfluid, defined by the classical equations of hydrodynamics.

[5] Because of its entropic behavior the individual granule lives in a dimension well below direct experimental observation.

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

A fairly straight forward experiment to test this approach would be to perform a slit screen experiment where (1) the apparatus is contained in a small volume appropriately shielded from any external entropic/isotropic flow, and (2) the electron source and the recording plate are equidistant from the double slits.

Under those conditions the conjectured mechanism would appear to be verified if there is no detected pattern of apparent electron "interference." To see this we first examine the slit screen experiment from the point of view of the conjecture where conditions (1) and (2) do not hold.

Consider the slit screen apparatus *before* an electron goes through.

Without conditions (1) and (2) the volume of space behind the electron source (the lab space) will, in general, be greater than that between slit screen and detector. As a result the entropic/isotropic pressure entering the apparatus will be 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. This scattering is marked by the limitation that incoming scattered granule rays can be no closer together than the radius of a single granule (the space between adjoining rays being filled with outgoing granules). And, as Figure 1 below indicates, this limitation implies that the scattering cannot be everywhere dense, that there will be areas on the detector screen inaccessible to the incoming rays.

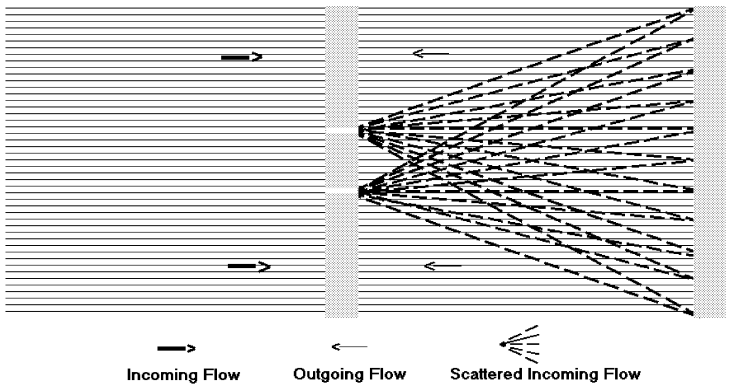

FIGURE 1[7]

Now consider what this implies when we send an electron through a pinhole of radius 1 mm. With radius of about 10^{-14} mm the electron would be entering a flow 10^{14} times its size. Since the probability of the electron escaping such a flow appears unlikely we therefore assume, at least for the purposes of the argument here, that the electron will be captured by the

[7] Figure 1 shows, in horizontal hash lines, only a suggestion of the exiting entropic rays, and, in angled lines, only a suggestion of the entering entropic rays. The diagram can only be suggestive since even with a pinhole radius of 1 mm radius, with the granules of each entropic ray of approximate Planck radius, i.e., 10^{-34} mm, there would be approximately 10^{34} rays at each slit.

flow.

As a consequence, just as there are sections of the detector inaccessible to the flow, so will they be to the electron.

Ergo, by our conjecture, "interference" arises because of the scattering induced by the difference in pressure between the incoming and outgoing entropic/isotropic flow.

We can test this conjecture by modifying the slit screen experiment to insure that the incoming and outgoing pressures are the same. If no interference pattern arises under these circumstances the conjectured mechanism for space-time flow would be strongly confirmed.

To insure that the incoming and outgoing flow pressure are the same we require nothing more than adding to a split screen setup the conditions indicated above: (1) a shielding of the apparatus from external entropic/isotropic flow[8], and (2) a placement of the slit screen midpoint of the electron source and the detector screen.

Under these circumstances if no interference pattern emerges, thus confirming the entropic/isotropic flow mechanism, our understanding of such matters as electron duality, the Aharonov-Bohm effect, the Casimir force and the deBroglie-Bohm pilot wave may be considerably deepened.

Confirmation of the granular flow mechanism might also provide insight into the nature of "dark matter," this by way of the non-zero probability of space-time granules occasionally being in a state of mass-like anisotropic periodic pulsing (mass-like in the sense of $m = \hbar\nu/c^2$ [9]) until forced back to isotropic/entropic behavior by their neighbors.

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[8] Since, by definition, the conjectured granules of space-time penetrate all of "empty" space, blocking external rays from entering the apparatus will require the shielding to be fabricated from material of high anisotropic density, perhaps copper with its free electron density of $8.49 \cdot 10^{19}$ mm^3.

[9] By $E=mc^2=\hbar\nu$