Testing a Conjectured Space-Time Model

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Abstract

An experiment is proposed to test a conjectured space-time model.

In a recent Letter[1] S. Liberati and L. Maccione attack the century old paradox of a space-time that on the one hand, from Michelson-Morley, must be viscous free and yet, on the other, must contain sufficient structure to respond to the gravitational field equations.[2]

The authors' solution was to impose certain sub-Planck constraints on any such structure which constraints, they conclude, provide "the very important information that any viable emergent spacetime scenario should provide a hydrodynamical description of the spacetime close to that of a superfluid."

The following conjecture presents a promising scenario for such a hydrodynamical description. 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 radius at or below Planck length[3] then to preserve the isotropy required by special relativity[4] these granules cannot be in static anisotropic lattice form. They must be in a state that is near to or at least approaching maximum entropy, deforming rapidly and randomly. And since increasing entropy is the favored state of nature[5] [6], this necessarily implies an entropic/isotropic hydrodynamical flow of these granules moving from isotropic to anisotropic regions of space-time.

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[1] S. Liberati, L. Maccione, "Astrophysical Constraints on Planck Scale Dissipative Phenomena," *Phys.Rev.Lett.*, **112,** 151301 (2014).

[2]Einstein adverted to this problem as early as 1920. *See* 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. For a modern review of the literature on a non-viscous space-time models amenable to curvature *see* M.C. Duffy, **"**The Ether Concept in Modern Physics," Physical Interpretations of Relativity Theory, Proceedings of International Scientific Meeting PIRT-2005 (Moscow: 4 – 7 July, 2005), http://www.space-lab.ru/files/news/PIRT_2005/text/PIRT_05_eng.pdf, 77-89.

[3] For a 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).

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

[5] S. W. Hawking, "Arrow of time in cosmology," Phys. Rev. D 32, 2489(1985).

[6] While an expanding universe is one natural implication from Hawking's position it may also simply imply that while by chance or necessity anisotropies have emerged, and continue to emerge, in the formation of the universe, these are but temporary and isotropy and maximum entropy in the end will always prevail.

Indeed since the manifold defined by this structure would be by definition experimentally "smooth" (since individual granules live in a dimension well below direct experimental observation) it is already equipped, algebraically, with such a flow.[7]

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 such conditions the conjectured mechanism can be tested as follows.

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.

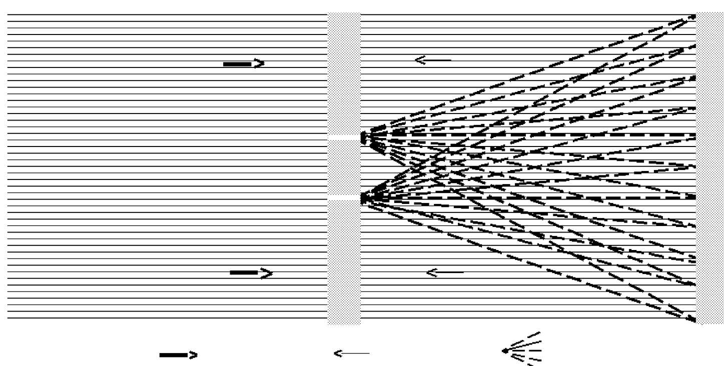

FIGURE 1[8]

Now consider what this implies if we send an electron through a pinhole of radius say 1 mm. With its own radius being about 10^{-14} mm the electron would be

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

[8] 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.

entering a flow 10^{14} times its size, and since the probability of the electron escaping such a flow appears unlikely we therefore assume, at least for the purposes of argument, that the electron will be captured by the flow.

As a consequence, just as there are sections of the detector inaccessible to the flow, so will they be to each and every electron entering the apparatus. The isotropic flow generates an experimentally "invisible" interference pattern. Each electron as it follows the flow will contribute to a very visible pattern.

The conjecture implies therefore that "interference" arises not from the duality of the electron but rather because of the scattering induced by the difference in pressure between the incoming and outgoing entropic/isotropic flow.

And there is a way to test this somewhat stunning implication.[9]

We can test it by modifying the slit screen experiment to insure that the incoming and outgoing pressures are the same, so there is no scattering of the space-time rays, so there is no predetermined detection pattern for electrons entering the apparatus to follow.

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[10], 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 anisotropic periodic pulsing (mass-like in the sense of m = $\hbar\nu/_{c^2}$ [11]) until forced back to isotropic/entropic behavior by their neighbors.

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[9] Of course none of this, if true, would seem to affect the formalism of the Quantum approach since the Psi function now becomes simply a description of the "invisible" space-time flow.

[10] 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.

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