International Journal of Theoretical Physics, Vol. 21, No. 2, 1982

Quantum Theoretical Physics is Statistical and Relativistic. II

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Received March 12, 1981

The vanishing divergence of 4-velocity, crucial to our theoretical basis for a classical statistical quantum mechanics, is investigated further. We demonstrate that this property of 4-velocity is of purely relativistic—kinematic origin. So, unlike our treatment in the initial work, we need not constrain the environment to that of electromagnetism; a superior argument results by the analog of a relativistic particle's world line with fixed curves in a Euclidean 3-space, such that $\square \cdot \mathbf{v}=0$ iff $(\mathbf{v})^2=-1$!

1. INTRODUCTION AND SUMMARY

It was shown, in equations (2.14)→(2.19) of Harding (1980; referred to as [1]), that (2.3)[1] holds if one restricts a single relativistic particle's acceleration to arise from interaction with an electromagnetic field. If it is to yield a viable classical quantum mechanics, (2.3) must be independent of an environment. In what follows, we shall consider a conjecture, given as (2.1)⊃(2.3) of [1], and see that (2.3), "in fact," exists as a direct consequence of the kinematics (2.1); this is possible only within the framework of relativistic theory!

2. ON THE RELATIVISTIC KINEMATICS OF 4-VELOCITY

At any point $\mathbf{r}$ on a fixed curve in Euclidean 3-space, there is a unique triad of orthonormal vectors. By convention these are the unit tangent $\hat{\alpha}$,

[1] At the bottom of [1], page 925, Equation (2.2) should be substituted by (2.3).

0020-7748/82/0200-0149$03.00/0

principal normal $\hat{\beta}$, and, binormal $\hat{\gamma}$:

$$(\hat{\alpha})^2 = (\hat{\beta})^2 = (\hat{\gamma})^2 = 1 \tag{1}$$

$$\hat{\alpha} \times \hat{\beta} = \hat{\gamma}, \qquad \hat{\beta} \times \hat{\gamma} = \hat{\alpha}, \qquad \hat{\gamma} \times \hat{\alpha} = \hat{\beta} \tag{2}$$

$$\hat{\alpha} \equiv \frac{d\mathbf{r}}{ds} \tag{3}$$

where s is the curve's arc length and is positive wrt $\hat{\alpha}$.

By a local coordinate transformation, we can make the new x, y, and z parallel to $\hat{\alpha}$, $\hat{\beta}$, and $\hat{\gamma}$. An "infinitesimal" cube is constructed, with its edges parallel to x, y, and z, and center at $\mathbf{r}$. As such, we see that what enters and leaves faces of the cube by this vector $\hat{\alpha}$, yields a zero partial derivative with respect to x; the divergence theorem, nevertheless, is written in its invariant form:

$$\oint_{\Sigma} (\hat{\alpha} \cdot \hat{n})\, d\sigma = \int_{\Upsilon} (\nabla \cdot \hat{\alpha})\, d\tau = 0 \tag{4}$$

where $\hat{n}$ is a unit vector perpendicular to $d\sigma$ and points out wrt Σ:

$$\nabla \cdot \hat{\alpha} \equiv 0 \tag{5}$$

By extending our proof from Euclidean geometry to its analog in Minkowski space-time, $(\mathbf{v})^2 = -1$ leads to $\Box \cdot \mathbf{v} \equiv 0$.

So, by [1], QM is *Classical-Statistical* & ***Relativistic***!!

REFERENCES

Harding, C. (1980). *International Journal of Theoretical Physics*, **19**, No. 12, 925.