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Rotational Solutions Under the New Theory of Motion

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Abstract

The author recently introduced a new theory of motion which resolves several problems in the philosophy of physics and mathematics by replacing the continuum with nonvanishing time. Nonvanishing time means that the magnitude of an instant does not have the functional properties of zero, even though it may be very small. As a result, joint functions of time, such as $s = vt$, vary as the other terms even when time is instantaneous. Hence size (vdt or instantaneous position) is increasing as velocity. This paper presents some quantitative solutions to the above for the case in which a point of mass m is resolving in a perfect circle with uniform speed $v = \omega r$. The magnitude of an instant dt—the minimum time for real events—is found by obtaining the magnitude of the arc ds along which the rotating point is distributed over dt time. Under the Heisenberg uncertainty principle this turns out to be $ds^2 = h(m\omega)^{-1}$. If the de Broglie equation and Einstein's two equations for photon energy are introduced, then in general $ds^2 = \lambda r$. Under the quantum mechanical definition of orbital angular momentum $\lambda r^{-1} = 2\pi n^{-1}$, where n is the integral scalar for $\hbar$. Hence there is an asymmetry on the right side of the last expression for ds, and the ratio of ds to the circumference of the circle is $(2\pi n)^{-1/2}$.

1. *Introduction*

In two previous papers (Allen, 1974, 1975), the author has shown that a number of problems in the philosophy of physics and mathematics can be resolved by replacing the classical idea of the continuum with nonvanishing time. Under this new theory of motion, the magnitude of an instant of time does not have the *functional* properties of zero, even though it may be thought of as a good numerical approximation for zero. As a result, joint functions of time vary as the other terms even when time is instantaneous. As shown in the second referenced paper, this definition of an instant produces results which are very much in keeping with the spirit of modern physics. Yet, these results are most contrary to classical intuition because the size (instantaneous position) of an object is increasing as velocity. For example, the instantaneous position of a spinning rod is sector-like rather than rod-like. This is because a section of the rod r distance from the locus moves $s \propto r\Delta t$ distance over Δt time, and the relationship $s \propto r$ holds even when $\Delta t = dt$. The philosophical problem this resolves is the problem of mapping a spinning line onto (and not merely into) the continuous area of a circle.

The purpose of the present paper is to introduce some quantitative solutions to the new theory's equations of motion in the case of a uniformly rotating point of mass. This should provide additional insight into the theory's implications, while at the same time making the theory more meaningful for the working physicist.

2. *Solutions for Uniform Angular Motion*

Consider a point of mass m revolving in a perfect circle with a uniform speed of $v = \omega r$, where ω is angular speed, and r is the distance from the mass to the locus of its path. Consider also a small positive time increment Δt during which the mass moves through an arc of magnitude $\Delta s = v\Delta t$, having angle $\theta = \omega\Delta t$, and chord Δx. Associated with the arc is a pair of instantaneous velocities for the mass, tangent to its path at the bounds of the arc. Since v is uniform, the magnitude of these two velocities is the same. However, there is a vectorial difference between them, $\Delta\ddot{v}$. With elementary geometry it can be shown that

$$\Delta\ddot{v} = \Delta x v r^{-1} = \Delta x \omega \tag{2.1}$$

For these terms to remain observable it is necessary that

$$h \leqslant m\Delta\ddot{v}\,\Delta s \tag{2.2}$$

Substituting the angular form of the right side of equation (2.1) for $\Delta\ddot{v}$ in (2.2), and collecting space parameters on the right, one obtains

$$h(m\omega)^{-1} \leqslant \Delta x\,\Delta s \tag{2.3}$$

Suppose now that smaller and smaller increments of time are taken for the magnitude of Δt. Since $\theta = \omega\Delta t$, this produces smaller and smaller magnitudes for θ. Hence, this also produces smaller and smaller magnitudes for the right side of inequality (2.3), because both coefficients on the right of (2.3) are increasing as θ. As a result, the decreasing of Δt eventually reaches a point where one can write

$$h(m\omega)^{-1} = \Delta x\,\Delta s \tag{2.4}$$

In addition to bringing the space parameters down to their observable limit, the diminishing of θ has also made Δx a good approximation for Δs. Thus one may rewrite equation (2.4) as

$$ds^2 = h(m\omega)^{-1} \tag{2.5}$$

where ds is written instead of Δs to indicate that this is the smallest observable magnitude for the arc. It then follows from equation (2.5) that the smallest observable increment of time is

$$dt^2 = h(m\omega^3 r^2)^{-1} \tag{2.6}$$

In other words, equation (2.6) gives the length of time it takes the rotating mass to move (or in the sense of the present theory, to be) across the smallest observable arc. The classical idea that dt can grow indefinitely small does not have much meaning since all time increments shorter than the one indicated are equally unobservable. In other words, real events cannot take place in less than $h^{1/2}(m\omega^3 r^2)^{-1/2}$ time.

3. *Discussion*

If the rotating point in the previous model has a waveform with the wavelength obtained through de Broglie's equation (or, for a photon, by combining the two Einstein expressions for its energy), then equation (2.5) can be written as

$$ds^2 = \lambda r \tag{3.1}$$

Similarly, equation (2.6) becomes

$$dt^2 = r(\nu v)^{-1} \tag{3.2}$$

where $v = \lambda\nu$. Note that the case $ds = \lambda = r \Leftrightarrow \omega = dt^{-1}$, i.e., $\omega dt = \theta = 1$ radian, produces the inconvenient result $h = mvr$. Setting h equal to the more desirable expression $2\pi rmvn^{-1}$, where n is a natural number, and substituting this expression for h in (2.5) and (2.6), one obtains

$$ds^2 = 2\pi r^2 n^{-1} \tag{3.3}$$

$$dt^2 = 2\pi r^2 (nv^2)^{-1} \tag{3.4}$$

Equation (3.3) is convenient for the spin-problem mentioned in the Introduction because n is a dimensionless scalar so that $ds \propto r$. In this same regard, note that r is not really an independent variable in (3.4) since (3.4) can be rewritten

$$dt^2 = 2\pi(n\omega^2)^{-1} \tag{3.5}$$

The present role of the scalar n is that $(2\pi n)^{-1/2}$ gives the ratio of the instantaneous arc ds to the complete circular path of the rotating point, and similarly, the ratio of the instant dt to the period of revolution. This can be obtained from equations (3.3) and (3.4), but more directly from equation (3.1) and the fact that the relationship $\lambda r^{-1} = 2\pi n^{-1}$ is implicit in quantum mechanics (through the de Broglie equation and the definition of $\hbar$). Hence, unless one is willing to think of n as infinitely large, one should not think of dt as infinitely small. In other words, in observing a rotating particle over a decreasing interval of space (time), one increases his information on the direction of linear velocity. Thus, as indicated by equation (2.5), the interval of space (time) cannot go to zero unless the measuring process drives the product of mass and angular speed to infinity so that one will have no information on the particle's momentum (energy).

References

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