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GRAVITY SHIELDING BY COMPLEX SPIN

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Since the concept of gravity was first formulated by Sir Isaac Newton it has been possible for the average person to have a fairly adequate picture of gravitation phenomena. The usual picture is similar to electrostatics since the force between masses (charges), is proportional to the product of masses (charges) divided by the square of the distance of separation. A particular point of difference from the electrostatic case however is that the force of gravity is always one of attraction. Another striking observation is that the weight (force of gravity) of an object is directly proportional to its inertial mass--that is, the action of gravity appears to be equivalent to an acceleration and is indeed usually referred to as the acceleration of gravity, and expressed in units of length/time^2. As the principles of general relativity have become more widely appreciated, it has been generally recognized that this equivalence is more fundamental than coincidental.

A favorite illustration is that of an observer in a closed elevator car which may be undergoing acceleration in a gravitational field. It can be seen that whatever experiment this observer may make to determine the direction and magnitude of gravity or the direction and magnitude of his acceleration is doomed to failure as he can observe only the vector resultant of these two "accelerations". An important point which is often overlooked in the foregoing is that this inseparability of gravity and acceleration occurs only for the case of a uniform homogeneous gravitational field. This is not a serious limitation in our everyday experience since we normally consider vertical lines as being parallel over the limited region of our experience. However, some important observations may be deduced from a more rigorous consideration of the divergent field. Returning to the case of our observer in the hypothetical elevator, let him now make his measurements at two locations within the car, obtaining two values for the resultant "acceleration". By suitable vector manipulations he may then separate the components due to the earth's gravitational field from those due to the acceleration of the car. However, it will be noted that he can perform this operation only if his frame of reference is not undergoing angular acceleration, which would introduce different force components at the two observation stations within his frame. Thus it is seen that we have now noted a second order equivalence; just as a uniform gravitational field appeared the same as a linear translational acceleration it now appears that the divergence of an actual gravitational field may give rise to the same effects as an angular acceleration. It is the purpose of this paper to investigate this latter effect further, with the aim of shedding additional intuitive light on the physical nature of gravity. It is felt that this emphasis on the intuituve approach, rather than one of mathematical rigor, is appropriate in that it may bring an appreciation of the subtle nature of gravity closer to more people and it is most likely that any strides in the achievement of gravity insulating, reflecting or absorbing devices will most readily come from having a large group of people familiar with the related phenomena.

To appreciate the nature of the problem at hand, consider the case of two observers having an angular velocity with respect to each other but isolated from all else--that is, in a "universe" all their own. It can be seen that the first observer would assume himself at rest and, observing the angular velocity of the second, would postulate that the second observer and conclude er would be experiencing a centrifugal force. However, the second observer could equally validly make the same arguments relative to the first observer and conclude that the first observer is the one experiencing centrifugal force. To resolve this paradox we must introduce the concept of rotation <u>with respect to</u> inertial space or the totality of gravitating matter.

To decide when one is at zero angular velocity with respect to inertial space, an examination of Newton's classical water pail experiment will be most helpful. Let us again consider our observer in the elevator car and this time provide him with a pail of water. If his system is at rest rotationally, the water in the pail will assume a plane surface. However, should he be undergoing rotation, either clockwise or counter-clockwise, the surface of the water will assume the shape of a parabaloid, the curvature of which is proportional to the angular velocity of the system. For purposes of simplification, our observer would naturally choose the condition resulting in a plane surface and define that as corresponding to zero angular velocity. However, let us now examine the situation a bit more critically. If the pail is at rest in the earth's gravitational center. Here a most interesting fact may be observed: the divergence of the gravitational field and the angular velocity have similar effects in that they cause a curvature of the otherwise planar surface but a striking fact is that the effects are opposite--gravity results in a downward concavity (center of curvature is in the direction that the water is attracted) but the rotation results in an upward concavity (the center of curvature is located in the opposite direction from that in which the water is attracted).

Since over the region of interest the parabaloid is an excellent approximation to a sphere, it will be seen that there is some value of angular velocity for which the water surface is maximally flat. It is of interest to evaluate this numerically in approximate figures. The "drop" of the geoid in one foot horizontal distance is approximately 2.4×10^{-8} feet, which can be compensated for by the upward deflection corresponding to approximately 12.5×10^{-4} rad/sec, or a rotational rate of seventeen revolutions per day. Since the amount of upward deflection is proportional to the square of the angular velocity, it can be seen that this conditions of a planar geoid will obtain for either clockwise or counterclockwise rotation of the region of interest. It now appears that by the imposition of a real physical spin or rotation, we may perturb the geoid to the extent of making the gravitational equipotentials less convex, plane, or as concave as we wish. We cannot however make the geoid more convex in this manner, nor can we decrease the downward force of gravitational attraction. That is to say, if we impose a rotation upon a region, the effect will be to raise the geoid in the surrounding space, or in other words, increase the apparent gravity in the region.

Since the gravitational perturbations achieved are a function of the square of the angular velocity, and are consistently opposite to those desired, it may be argued that the desired effect may be achieved by the imposition of an imaginary or complex spin. Such a spin would produce a more convex geoid and decrease the observed magnitude of the gravitational potential. Such a condition would enable one to adjust the intensity of the gravitational field at will, which is the requirement for a gravity reflector or absorber.

It may be objected that external energy would have to be supplied to achieve this condition, but it is felt that this cannot be determined with certainty until a more accurate picture of the nature and consequences of complex spin is obtained. An analogous illustration from the realm of the microscopic may be helpful in making this viewpoint more tenable. Recalling the early state of atomic physics, it appeared that nuclei were surrounded by electrons which were spinning and revolving in orbital paths. An objection to this model was raised based upon the assertion that since the electrons were charged particles undergoing centripetal acceleration they must radiate electromagnetic energy and ultimately fall into the attractive field of the nucleus. To counter this obstacle, it was proposed that there existedcertain preferred discrete orbits which could for some reason be traversed without suffering radiation. This did not appear to be a completely rational explanation of atomic phenomena, but it did serve as a most useful and powerful intuitive model, allowing great strides to be made in atomic physics. Subsequent wave mechanical theories resolve the difficulty by pointing out that our mechanical planetary model was too naive; we now realize that the concepts of spin and orbital motion must be thought of as analytical fiction rather than a realistic model. However, the important point is that by disregarding certain apparent objections which were not well understood, we were nevertheless able to make many valid predictions based upon the positive aspects of our intuitive model.

It is felt that in a similar manner, if we set aside the difficulty of visualizing a complex spin, we may draw heavily upon it as a model upon which to base experiments in the reflection, absorption or shielding of gravity. It may well be that future investigations will show that this approach will have served its purpose by guiding experiments in the right direction, even though the "spin" talked of turns out to be a much subtler phenomenon than we can now describe. It is not, in fact, unreasonable to hope that in this elusive "spin" concept we may ultimately find the common denominator for a true unified field theory, combining the macroscopic, relativistic phenomena on the one hand with the microscopic quantum mechanical phenomena on the other.