On the Possibility of Discovering Reflectors or Absorbers of Gravity and of Constructing Effective Sources of Gravitational Waves

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It is well known that present-day theory predicts the impossibility of shielding against static gravitational fields by methods comparable to that of shielding against electrostatic fields by a Faraday cage. The reason for this is that the present-day theory denies the possibility of making matter of negative mass. The theory also predicts interactions between matter and non-static gravitational fields so weak that matter for all practical purposes would be transparent to gravitational waves, making gravitons unobservable.

This theory reflects what until now is known experimentally about gravity and matter. If gravity would have properties unknown as yet to mankind, these properties would have to be found experimentally, thus forcing theoriticians to change their theories and to adjust them to facts found against their expectations.

How could one perform experiments by which to discover absorption or reflection of gravitational waves in measurable amounts? As in experiments on absorption or reflection of light or of radiowaves, one needs (a) a source of radiation, and (b) a detector. Substances to be tried on gravito-absorbing or reflecting power can then be placed in between.

Before one can detect gravitational radiation, one first must create this radiation. Suppose there existed some extraordinary material with a much stronger interaction with non-static gravitational fields per gram of its weight, then theoretitians would predict. Sources as well as detectors of gravity radiation made out of such materials if they exist would be the most effective ones. But finding such materials if they exist would be a haphazard business, and when an effect were found, one would not even know whether one would be observing an effect of gravitational radiation

or of something else.

One would know how to operate with gravitational radiation if the source were made out of conventional materials satisfying existing gravitational theories. Therefore the task of this essay is to discuss whether one can theoretically expect to be able to build an effective gravity radiator out of normal matter.

Calculations of gravity radiation have been made in the past on the basis of Einstein's gravitational theory.[1] In contrast to them, we have based our present calculations on a new, Lorentz-covariant, linear theory of gravitation recently developed by Belinfante and Swihart.[2] Although theoreticians are tempted to prefer Einstein's theory to this new theory of Belinfante and Swihart, there are as yet no convincing direct experimental proofs that Einstein's theory is better than the new one. The latter explains Mercury's perihelion motion and the deflection of light rays passing along the sun equally well if not better than Einstein's theory; it yields the same gravitational red shift as Einstein's theory, and also explains the validity of the principle of equivalence of gravitational and of inertial mass.

The gravitational field is given by the retarded action caused by the matter sources. The effects of the latter sources have been expanded in powers of v/c, where v is the velocity of the source. We neglect all powers higher than second in v/c.

We first calculate the Wiechert-Liénard-type gravitational potentials. From the latter we derive the gravitational energy density and energy flux away from the source. The entire density tensor for this purpose is derived according to conventional field-theoretical methods.[3] We calculated these quantities in the so-called "wave zone", by neglecting terms in energy density and flux dropping off with distance faster than r^{-2}.

Choosing the constants of the theory for maximum similarity to Einstein's experimental predictions,[4] we find the following expression for the outward gravitational energy flux S in the wave zone in the field around a "rotator" with all masses concentrated on a line rotating with an angular velocity ω in a plane:

$$S = C[(\cos\Theta)^2 + \tfrac{1}{4}(\sin\Theta)^4(\sin 2\omega t)^2] - B(\sin\Theta)^2(\cos 2\omega t).$$

Here, Θ is the angle between the direction in which the flux is observed, and the axis around which the linear rotator is turned; t is the time of observation measured from an instant at which the linear rotator is seen perpendicular to the line of sight. If E is the non-relativistic kinetic energy of the rotator, and m is its (rest) mass, if $G = 6.67 \times 10^{-8} cm^3 g^{-1} sec^{-2}$ and $c = 3.00 \times 10^{10}\ cm/sec$, then C and B are given, at a distance r from the rotator, by