phase shift; C determines the power loss from the source. When a time-symmetric local absorber with response factor h is introduced we have, following Pegg[3],

$$f=h+(1-h)f_1 \quad (2)$$

$$p=h+(1-h)p_1 \quad (3)$$

where f_1 and p_1 describe the response of the Universe outside the local absorber. Equations (2), (3) and (1), after rearrangement, yield

$$(1-h)(2-f_1-p_1)C=(1-h)(1-p_1) \quad (4)$$

Even for a near perfect local absorber, $h\approx 1$, equation (4) reduces to the form of equation (1), and thus C is still determined only by the properties of the Universe outside the local absorber. The advanced and retarded effects of the local absorber on C have cancelled.

An experiment which is to influence the power loss would need a time-asymmetric local absorber, for example a moving absorber which gives rise to differing amounts of absorption at the different times it is acted on by the retarded and advanced radiation. For this case we would replace h in equations (2) and (3) by h_r and h_a respectively. An optimum experiment, perhaps performed with radiation pulses through a rotating chopper, would give $h_r\approx 1$ and $h_a=0$, having the effect of increasing C to its maximum value.

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Electrostatic Redshift

IN his recent book *Relativity Reexamined* the late Leon Brillouin presents an interesting discussion of the problem of the interpretation of potential energy in special relativity theory[1]. He considers the radiation characteristics of an atom in a region of high electrostatic potential (for example, in the dome of an electrostatic accelerator) as compared with one at zero potential and points out the reasons why one should expect the spectral characteristics to be the same. Brillouin then cryptically mentions that these arguments are empirically verified. Presumably, he refers to the experiments of Kennedy and Thorndike[2] and Drill[3] in which an electrostatic analogue of the gravitational redshift was sought. Neither Kennedy and Thorndike nor Drill attempted to deduce theoretically the quantitative prediction of general relativity theory for the electrostatic redshift; rather, they appear to have proceeded in a purely experimental/intuitional fashion. In order to show that their null result was to be expected and that the electrostatic redshift is inaccessible even with present techniques, we now give a brief derivation of the general relativistic prediction for this effect.

As is well known, general relativity theory predicts a redshift which satisfies

$$\Delta\nu/\nu=1-(g_{00}/g_{00}')^{1/2} \quad (1)$$

where ν is the frequency of the source, $\Delta\nu$ the frequency shift of the source measured at the location of the observer, and g_{00} and g_{00} the coefficient of the time-like coordinate of the differential line element (ds^2) corresponding to the appropriate metric at the position of the source and observer respectively. Noting that exterior to the dome of an electrostatic accelerator the appropriate metric is that for a point charge deduced by Reisner and Nordstrom (since the charge on the dome is equivalent by Gauss's theorem to a point charge) and that, for physical reasons, the metric must be continuous passing from the exterior to the interior of the dome, it follows that g_{00} at interior points will be the g_{00} of the Reisner–Nordstrom line element evaluated at the surface of the dome. That is,

$$g_{00}=1-2GM/Rc^2+4\pi GQ^2/R^2c^4 \quad (2)$$

where c is the speed of light, G the constant of gravitation, R the radius of the dome, M the mass of the dome, and Q the charge on the dome. Since we are only interested in the electrostatic effect, the second term of equation (2) may be dropped. Also

$$Q/R=\varphi \quad (3)$$

where φ is the electrostatic potential of the dome. Thus, equation (2) may be rewritten in this case as

$$g_{00}=1+4\pi G\varphi^2/c^4 \quad (4)$$

If we assume that we observe the radiation from the source located inside the dome in a region of zero electrostatic potential, equation (1) then is

$$\Delta\nu/\nu=1-(1+4\pi G\varphi^2/c^4)^{1/2} \quad (5)$$

as $g_{00}'=1$. Since $4\pi G\varphi^2/c^4$ will be small in any realisable experiment, we have

$$\Delta\nu/\nu-2\pi G\varphi^2/c^4 \quad (6)$$

Thus for a source in an electrostatic accelerator of several MeV, $\Delta\nu/\nu\sim 10^{-40}$, a value at least twenty orders of magnitude smaller than the best possible frequency discrimination presently available employing nuclear resonance techniques. In view of the above, the results of Kennedy and Thorndike and of Drill are to be expected. It is regrettable that the electrostatic redshift prediction is not presently amenable to empirical verification.

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Was the Evolution of the Atmosphere Continuous or Catastrophic?

THERE seems now to be general agreement that the atmosphere has evolved as later degassing from the solid Earth[1-3]. The degassing mechanism, however, is still controversial. One school considers that the degassing has been a continuous process throughout the history of the Earth[1,4,5]. For example, Turekian[4] discussed the continuous degassing model on the basis of Ar evolution in the atmosphere. Assuming that the degassing obeys a first order rate process, he obtained