Radiative and Dynamical Implications of Electrogravity

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The term "electrogravity" (EG) is suggested for the force acting in processes such as the redshift, QSOs, the CBR and processes that resolve the background paradoxes, where gravitation and electromagnetic radiation are both strongly present and affect each other. Radiation due to EG is denoted by EGR, and parallels between EGR in QSOs (and to a lesser extent in galaxies) and EGR in the form of the CBR are pointed out.

Electrogravitational dynamics (EGD) gives a theoretical unification of gravitational phenomena on various scales. Until now, several ad hoc forces or other additional hypotheses have been needed to explain these effects.

1. The Concept of Electrogravity

For a background, see Jaakkola (1983, 1991, 1993a). In this paper ideas presented there will be reconsidered and developed further, with emphasis on some astrophysical problems.

When dealing with radiation from discrete sources, we can in general, with exceptions discussed in Section 2, speak distinctly about an electromagnetic effect, but in more detailed treatments, its coupling with gravitation (electrogravitational coupling, EGC) must be taken into account. Gravitational processes in discrete mass systems are a distinct category as well, though EGC is always present in the effect. But when dealing with such processes as the redshift, the cosmic background radiation (CBR), the Olbers' and the gravity paradoxes, and high-redshift quasars, the cause and the effect, gravitation and radiation, are both so directly present and intermingled with each other that separating the two interactions becomes artificial and unnecessary. Radiation and its redshift effect are there gravitational effects, though measured by an electromagnetic standard. Even in such an apparently clear-cut case as Newton's law in the solar system, it should be noted that the measured, local value of the *G*-parameter is given by the EGC-process.

Therefore, while of course gravitation and electromagnetic interaction remain as separate notions, it seems necessary and useful to coin a new term "electrogravity" (EG), to be used especially in the connections just mentioned. This is done for practical purposes (e.g., "EG" instead of "electromagnetic interaction in the presence of electrogravitational coupling"). The term EG is also suggested here in order to advance our theoretical understanding of the effects, and simply because the two interactions are actually one.

2. Electrogravitational Radiation and Application to QSOs and Related Problems

Instead of CBR and the general redshift problem discussed previously (Jaakkola 1983, 1993), let us consider radiation from high-redshift QSOs. Redshift dims the energy of the photons emitted in the nuclear source at E_o such that it is observed at $E_o/(1+Z)$. These QSOs are, in most cases, non-cosmological (e.g. Arp 1987, Jaakkola et al. 1975), with high intrinsic redshift $Z_i \approx Z$. Absorption of the fraction $1-1/(1+Z) = Z/(1+Z)$ of the original energy hence takes place within the gravitation field of the quasar (by the EGC process). The absorbed energy must be re-emitted; therefore, a fraction $Z/(1+Z)$ of the flux from high-Z local QSOs originates in their gravitational fields. It is appropriate to call this "electrogravitational radiation" (EGR). Quite obviously, EGR is a gravitational effect, although light, and not weight, is measured. But is it not, nevertheless, more correct to term the interaction that causes the EGR electrogravity?

The case is quite different with the cosmological redshifts Z_c, since absorption (Z_c) and re-emission (EGR) occur in the space between the source and the observer. Here EGR is observed as CBR. Obviously EGR should have some spectral identity, even if observed in the extremely opposite forms of extreme compacity (QSO) or extreme diffuseness (CBR). Figure 1 illustrates this situation. In compact, flat-spectrum radio QSOs, which are

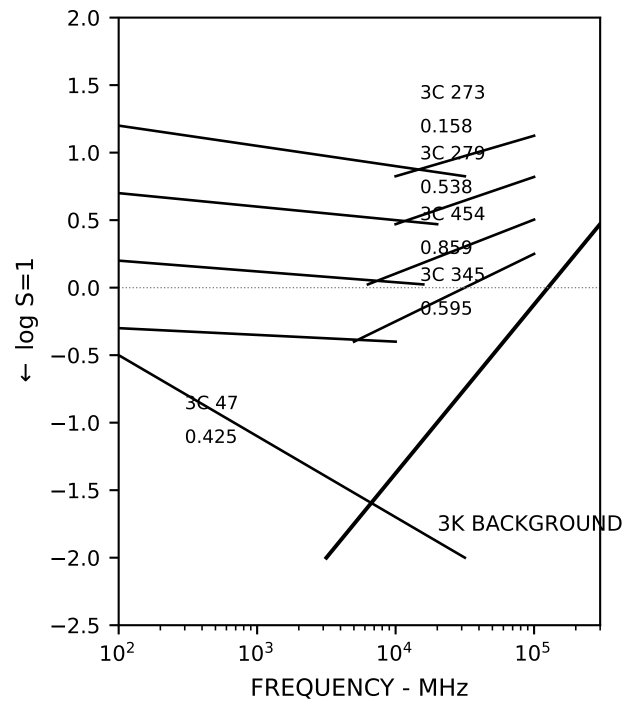

Figure 1: Illustrates a spectral relationship between quasars and the background radiation. Four upper curves are for flat spectrum (i.e. non-cosmological) QSOs, with the branches showing the variable spectra 1–3 years apart. Note the beginning of the flattening at the same frequency as where the 3° spectrum begins to rise. The straight, steep spectrum is probably for a cosmological QSO. The redshifts of the QSOs are given.

Z_i objects (Jaakkola et al. 1975), the spectrum begins to rise at the same frequencies as the CBR spectrum. The bump is absent, by definition, in steep-spectrum, extended radio QSOs, which have been shown to be Z_c-objects; hence, the characteristic EGR spectrum is not localized to the QSO in this case, but it is transferred to the microwave background where it necessarily assumes a blackbody form. Therefore, the EGR-hypothesis leads to a direct correspondence to the spectral morphology of the QSOs and the CBR.

High Z_i and high variability are correlated properties, both empirically and in the EGR theory. One does not expect violent variations either for low-Z_i objects, where EGR is low, or for very high-Z_i, where EGR is the principal radiation mechanism. Indeed, the Z-distribution for these objects has a broad peak centered at $Z/(Z+1) = \frac{1}{2}$ $(Z=1)$, and low and high Zs are deficient. This is the second notable consequence of EGR for the quasar problem.

Since EGC uniquely and universally causes the redshift effect, EGR and its variations should be observed with smaller amplitudes in more normal galaxies. This is true also for the Milky Way galaxy, with a variable "galactic aurora", indicated here as a specific prediction of EGR, for which observational tests should be made. At the same time, variations of the galactic gravitation field are expected, parallel to the radiation aurora. This may be implied in Tifft's data (1988), where he argues that he finds variations in high-accuracy redshift data within a few years' time. If true, this effect must have a local interpretation such as the one suggested. The effect should not be isotropic and it may change sign.

Because EGR increases as $Z_i/(1+Z_i)$, equivalent widths of the emission lines decrease accordingly. This is the observed Baldwin effect, usually given a quite different meaning. With Z_i large enough, emission lines sink into the EGR continuum, and the redshift cannot be measured. A cut-off is found at $Z \geq 2.5-3$, which is certainly not due to high-Z objects becoming too faint (see Figure 2). Perhaps $Z_i > 5$ can be measured, depending on the total EGR-spectrum and using techniques for processing faint spectral signals, but this does not alter the cut-off as a real physical effect. BL Lacs may be a class of objects with emission lines that have fallen into the rising EGR. The Hubble-relation is predicted to extend further toward $Z \approx 10$, when Z-measurements for steep spectrum double radio source QSOs with $m \geq 23$ become possible.

EGR observed in high-Z local QSOs means that redshift does not dim the source, either by the distance effect ($Z \approx Z_i$) or by the energy effect, since the Z-energy is re-emitted as EGR. (Also it may return with the graviton inflow to the nucleus and serve as an energy source; the total effect is the same.) Indeed, in the Hubble diagram for QSOs there is nothing suggesting a Hubble relation (Figure 2). However, the left side of the diagram, presumably due to the nearest and most luminous population at each $Z \approx Z_i$, curves like $2.5\log(1+Z)$, which should not be due to the energy effect $E_o/(1+Z)$. Either we have this relation between Z_i and intrinsic luminosity, or, if the latter remains constant with Z_i, it must be due to the term of the same form in the observational $K(Z)$-term.

For QSOs and galaxies with $Z = Z_c$ we obtain the following. Both the distance and the redshift effects dim the observed flux such that $f = f_o/[r^2(1+Z)]$. We obtain the following (m, Z)-relation:

$$m = 5\log\ln(1+Z) + 2.5\log(1+Z) + K(Z) + C \quad (1)$$

where the first term on the right is the distance effect (through the tired light relation $\ln(1+Z) = \alpha_c r = Hr/c$), the second is the energy effect, the third is the observational K-term, and the fourth involves the distance scale and absolute magnitude. Now, the long-standing mystery in empirical cosmology can be resolved: i.e. why since Hubble's observations in the 1930s the linear Hubble relation

$$m = 5\log Z + K(Z) + C \quad (2)$$

has always been obtained, even though there is no theoretical reason whatsoever for it. Equations 1 and 2 are numerically the same with an accuracy of $\Delta m(2-1) = 0.^{\mathrm{m}}0008$ at $Z = 0.1$, $0.^{\mathrm{m}}043$ at $Z = 1$, and $0.^{\mathrm{m}}5$ at $Z = 10$. The Gordian knot has been broken.

Therefore, there is a one-to-one correspondence between the EGR theory and observations of QSOs, galaxies and the CBR.

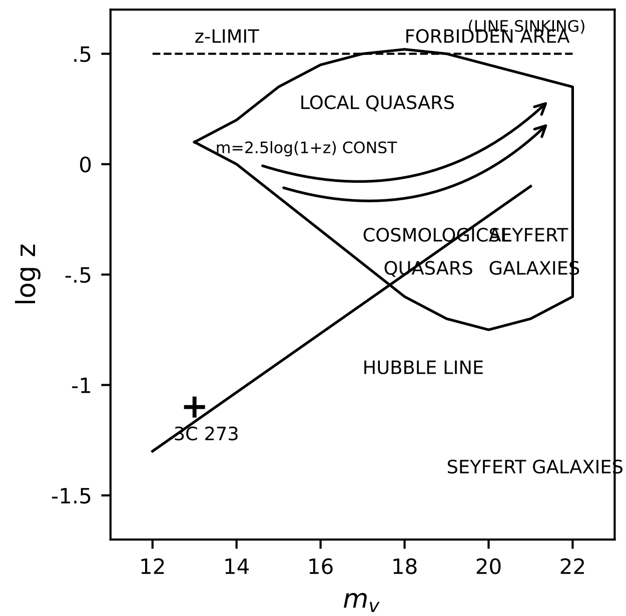

Figure 2: Interpretation of the Hubble diagram of quasars. The QSOs are within the wavy outline. The Hubble line is drawn through the QSOs with z equal to that of a nearby galaxy. The quasars on the left side edge of the distribution are the nearest ones, with z almost totally non-cosmological. The curved arrows show the distance effect for such QSO redshifts; note the accumulation in the upper right corner where there is also an extension in the observed distribution. Position of the QSOs vs. Type 1 Seyfert galaxies is due to distance-dependent morphology. Other details are apparent from the figure and from the text.

Many other features of QSOs and the redshift effect in general could be readily derived from the EGR theory.

3. Electrogravitational Dynamics, and Unification of Gravitation Effects in Systems of Different Scales

EGC affects dynamics. The concept of EG must be complemented by a concept of electrogravitational dynamics (EGD). It is an easy task to derive Newton's law from the present notion of gravitation as a pressure effect of gravitons flowing onto mass systems from the background gravitation field (Jaakkola 1993b). Owing to the EGC process, in large-scale systems the strength of gravitation, G, involving the energy of the gravitons, is a variable, $G(r)$; moreover, absorption of graviton energy by EGC according to the exponential law valid for absorption effects, $e^{-\alpha(r)r}$, must be taken into account in long-range interactions. The "generalized Newtonian force law", which defines the EGD-theory, follows from the adopted notions of gravitation and EGC:

$$a(r) = \frac{G(r)M(r)e^{-\alpha(r)r}}{r^2} \quad (3)$$

where $\alpha(r)$, in cm^{-1}, is the strength of redshift.

i. Cosmological Scale

Parameters have the values $G(r) = G_c \approx 10\,G_o = 6.67\times10^{-7}$ $\mathrm{cm}^3\ \mathrm{g}^{-1}\ \mathrm{s}^{-2}$, $\alpha(r) = \alpha_c = H/c \approx 6.33\times10^{-29}\ \mathrm{cm}^{-1}$, $M(r) =$

Table 1: Powers q in the functions $f(r) \propto r^q$ for various dynamical parameters f.

Region	ρ	M	a	V	G	α
Nuclear bulge	-1	$+2$	$+1$	$+1$	$+1$	-1
Visible outskirts	-2	$+1$	0	$+\frac{1}{2}$	$+1$	-1
Invisible outskirts	-3	0	-1	0	$+1$	-1
Solar system	-3	0	-2	$-\frac{1}{2}$	0	0

$\rho_c r^2\,dr$ per steradian. The Machian gravitational interaction of the masses within r or Z is given by

$$a(r,z) = \int_0^r G_c\rho_c e^{-\alpha_c r}\,dr = \frac{G_c\rho_c}{\alpha_c}\left(1-e^{-\alpha_c r}\right) = \frac{G_c\rho_c}{\alpha_c}\frac{Z}{1+Z} \quad (4)$$

When r and Z go to infinity, we have the cosmic force

$$a_c = \frac{G_c\rho_c}{\alpha_c} \quad (5)$$

which, for $\rho_c = 10^{-30}$ g cm^{-3} is $a_c = 1.1\times10^{-8}$ cm s^{-2}. Equations (4) and (5) are an explicit formulation of Mach's principle. The finite value of a_c resolves the Seeliger-Neumann gravity paradox.

Evidence that a_c is at work in the Universe is given by its similarity with the local acceleration $a_1 = G(R)M(R)/R^2$ at the edges of supergalaxies, clusters and groups of galaxies and single galaxies. Therefore, the Machian force is the factor which designs and controls macroscopic structure in the Universe. It sets the scale at which the transition from local hierarchic structure to the homogenous isotropic cosmological distribution occurs. Its finite value allows global stability.

ii. Galaxies and Clusters of Galaxies

Over a broad range of scales, a relation $a(r) \propto r^q$ with $q \approx -1$ has been obtained empirically (Jaakkola 1978a,b). At the basis of the EGC theory lies an equation (Jaakkola 1991, 1993a)

$$G(r)\alpha(r) = A = \text{constant} \quad (6)$$

which follows from conservation of momentum in the coupling of (outward) photons with (inward) gravitons. The density profile $\rho(r) \propto r^q$ steepens from the nuclear bulge ($q \approx -1$) outwards. For visible outer regions, $\rho(r) \propto r^{-2}$ follows the general fractal structure of matter distribution (Baryshev 1993). Still outwards, $\rho(r) \propto r^{-3}$, where the usual assumption of unseen matter is not made. Factor $e^{-\alpha(r)r}$ is practically one on these scales. Following from Equation 3 and the equality of potential and kinetic energies: $a(r) \propto \rho(r) \propto V^2(r)/r$, or $V^2(r) \propto r^3\rho(r)$. We obtain the power laws $f(r) \propto r^q$ for the dynamical parameters of EGD, with powers q given in Table 1.

Evidently, q changes smoothly between the regions. Observational values of q for $a(r)$ and $\rho(r)$ must be determined in future with greater accuracy.

The relation $V(r) \propto r^0$ found from Table 1 explains the flat outer rotation of spiral galaxies. The dependencies $D(r) \propto r$ and $D(R) \propto R$ of the mass discrepancy D, as well as the Tully-Fisher relation $L \propto V^2$, follow from $G(r) \propto r$. The transition rotation $V(r) \propto r$ follows from $\rho(r) \propto r^{-2}$. The observed rigid rotation in the nuclear bulge is obtained with $\rho(r) \propto r^{-1}$, while in classical dynamics $\rho(r) =$ constant is required, which is against all observations; this is the second mass anomaly in the constant-G Newtonian galactic dynamics. Because it is free from such problems, EGD gives the observed properties of galactic rotation. As for the clusters of galaxies, the upper two lines may be valid for their cores and outer parts. Empirical velocity data do not exist because the redshifts are strongly affected by non-Doppler intrinsic and intergalactic redshifts.

In Table 1 the dynamical parameters are also given for the solar system. It is interesting that the values closest to these figures come from the invisible disk. Flat rotation could, therefore, be called a "variable-G Keplerian motion" in galaxies.

iii. The Solar System

Here $M(r) = M_{\text{Sol}}$, $\alpha(r) = \alpha_o \approx 10\alpha_c = 10H/c$, $e^{-\alpha(r)r} = 1$ and, due to $r \ll R_{\text{Galaxy}}$, $G(r) = G_o = G$. The classical form of Newton's Law $a(r) = GM/r^2$ is obtained.

In more detailed issues, magnetic and radiation fields, resonances and interferences between the gravitation fields, and drag on moving bodies by the graviton medium may come into play. These are not at issue here; some of them have been discussed previously (Jaakkola 1991), and some have been dealt with quantitatively in the theory of velocity-dependent inertial induction (Ghosh 1986, 1991), which possesses many elements in common with the EGD.

Altogether, EGD contains a unified theory of gravitational phenomena in systems of different scales. Until now, picture of gravitation has been incoherent: a repulsive "fifth force" has been assumed for terrestrial observations, dark matter, ad hoc potential functions or a finite-scale repulsive force for galactic observations, and an ad hoc exponential factor or a cosmological constant, both implying a global repulsive force, have been introduced to explain the cosmological observations. EGD explains observations in all these scales directly from the fundamental theory without need to resort to ad hoc solutions.

Therefore, we may conclude that the theoretical framework of EG, EGR and EGD affords a consistent qualitative picture and powerful theoretical machinery to investigate radiation and gravitation in the Universe.

Acknowledgements

This paper was written during a visit to India as part of the cultural exchange program between Finland and India. The author wishes to express his gratitude for hospitality to the Indian Institute of Technology, Kanpur, the Inter-University Center for Astronomy and Astrophysics, Pune and the Tata Institute of Fundamental Research, Bombay; and in particular to Prof. A. Ghosh and Prof. J. Narlikar.

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