The law of gravity

We have not yet derived the inverse square law. A theory of gravity not only has to explain why there is a force of gravity, but also derive its force law. Let us consider Newton's conclusions. The first was that the force law must be an inverse square law. The second was that the three forms of mass, inertial mass, passive gravitational mass and active gravitational mass must all be equal. (Though it would be more correct to say that passive and active gravitational mass must be equal and that the constant of gravitation G is defined to have the value which makes them equal to the inertial mass.)

If we consider weak gravitational fields, then gravity simply inherits its force law from the properties of the electric fields of charged particles. This is because the physical entity which pervades space is the electric flux of elementary charged particles. The flux is continuous and its density (flux per unit area) therefore obeys an inverse square law. This would be an adequate explanation if the force of gravity were proportional to some electric property such as the sum of the magnitudes of the charges on the elementary charged particles $\sum_i |q_i|$ of the matter of the source, but the force is proportional to it mass. This leads us consider the nature of space and the electric field.

Many theories have regarded space as some form of substance. The assertion that space has the properties of permittivity and permeability lives on from Maxwell's understanding of the luminiferous medium as substance. Even Einstein with his insistence that the concept of an aether is superfluous ends up in his general relativity with a very substance like description of space time. The problem with regarding space as a substance is that it results in the view of electric and magnetic fields as being singular in nature. If the electric flux is given by $\vec{D} = \varepsilon_0 \vec{E}$ where $\vec{E} = \sum_i \frac{q_i \hat{r}_i}{r_i^2}$ we have no explanation of the magnetic action of moving charges. Our fundamental assertion is that space as such has no substance, but is pervaded by the substances of the electric fields of all the individual elementary charged particles.

In the author's early attempts to develop a theory of gravity, he thought of space as a compressible substance acted upon by the internal stress $\vec{D}_i \cdot \vec{E}_i$ of the electric fields pervading it. This internal stress is radial, but if space is fluid rather than solid, it converts to a pressure which has no direction. The problem with this concept is that gravitational potential does not squeeze space reducing its volume, but rather, it would seem to pack more volume into space. We see this concept (of GR) expressed in Cosmology's inflation theory. As the universe expands reducing gravitational potential, so space itself is said to expand. The author rejected such a notion as physically impossible.

We can grasp the concept of something being squeezed. Whatever it is that is being squeezed, it is related to the properties of permittivity and permeability. The way in which these two properties are defined depends on the system of units. Much physics is written in older systems of units where they are numbers. Only in SI units do they take on the guise of genuine physical properties. It seems reasonable to suppose that there is a property of space which is responsible for permittivity and permeability and that it is this property which we might think of as being squeezed, but such thinking needs to be further refined.

If we consider the effect of gravitational potential on an elementary charged particle, there is a readjustment of the structure of its electric field in which its total energy content is reduced and the structure of field and inner surface of the charge shrink. Since the radius of the charge has decreased, we might expect the energy content to increase by a factor of $e^{-\frac{\Phi}{c^2}}$ since $E_{el} = \frac{q^2}{8\pi \varepsilon_0 a}$, but this is not the case because the permittivity ε_0 increases by a factor of $e^{-2\frac{\Phi}{c^2}}$. It is a matter of historical accident that we have defined permittivity in the way we have. In the context of this discussion, the reciprocal property $\frac{1}{\varepsilon_0}$ would seem to be more fundamental. It would seem to be the property $\frac{1}{\varepsilon_0}$ which is squeezed by gravitational potential.

The energy content of the electric field of an elementary charged particle should then be written $E_{el} = \left(\frac{1}{\varepsilon_0}\right)\frac{q^2}{8\pi a}$. Energy is drawn from both the $\frac{3}{4}m c^2$ stored in the electric fields of the elementary charged particles and the $\frac{1}{4}m c^2$ which exists as potential energy due to the separation of positive and negative charges. Gravitational potential affects both equally. The direct action of gravitational potential is to reduce the value of $\frac{1}{\varepsilon_0}$ by a factor of $e^{2\frac{\Phi}{c^2}}$, but as a consequence of this the structure of the elementary charged particle reduces in size by a factor of $e^{\frac{\Phi}{c^2}}$ to attempt to compensate. The net result is that the energy content is reduced by a factor of $e^{\frac{\Phi}{c^2}}$. The electric potential $\phi = \frac{E_{el}}{2q}$ at the surface of the charge is also reduced by a factor of $e^{\frac{\Phi}{c^2}}$. The reduction in ϕ applies to the whole field and in particular to the potential energy charges have by virtue of their relative position to each other.

If we now consider the action of just two elementary charged particles on each other, it is evident that the gravitational action is reciprocal. They each have this effect on the other causing a reduction in energy content. The structure of each acts as a whole tying together the different properties of each of their electric fields. The effects on ϕ and a and $\frac{1}{\varepsilon_0}$ all relate to the effect on the energy content E_{el} and this process integrates these effects over the total $E = m c^2$ energy content. Gravitational action is therefore dependent on energy content rather than charge. This continues to apply as nature assembles a large number of elementary charged particles into a massive body which forms the source of a gravitational field.

So we see that while the force of gravity depends on mass, it does so because mass is a property of the nature of matter as an assembly of electric charges. Therefore is it the presence of the fields of elementary charged particles which allows the action of gravity and it follows that gravity must inherit an inverse square law from the nature of electric flux and the inverse square law obeyed by flux density.

The result is that the force of gravity is proportional to mass and obeys an inverse square law