# APPENDIX I

## Uniform Charge Induction in a Self-gravitating Electron-Proton Gas

Consider an electron-proton gas in which unit volume contains $N$ protons of charge $e$ and mass $m_p$ and $n$ electrons of charge $-e$ and mass $m_e$. Imagine a state of equilibrium which renders the electrodynamic interactions negligible compared with the predominant electric interactions and, owing to the large scale nature of the system, the gravitational interactions.

The equilibrium condition implies uniform mass density $\rho$ within the gas. It also implies zero net force on unit volume of electrons and protons due to the collective action of gravitation and the induced electric field. Hence, if the electric field intensity acting on this unit volume is $V$ and the gravitational field intensity is $g$, we have:

$$V(Ne-ne)+g(Nm_p+nm_e)=0 \tag{239}$$

Note that by writing $\sigma$ as the electric charge density this equation can be reformulated thus:

$$V\sigma+g\rho=0 \tag{240}$$

Since the gravitational force is attractive for mutual interaction we see from (240) that the electric interaction force must be repulsive. At radius $x$ in a spherically symmetrical system we find that $V$ is given by:

$$V=(1/x^2)\int_0^x 4\pi x^2\sigma dx \tag{241}$$

Similarly $g$ is given in terms of the Constant of Gravitation $G$ as:

$$g=-G(1/x^2)\int_0^x 4\pi x^2\rho dx \tag{242}$$

The uniformity of $\rho$ assured by the thermodynamic equilibrium then allows (242) to be evaluated as:

$$g=-\frac{4\pi}{3}G\rho x \tag{243}$$

From (240) and (243) we obtain:

$$V\sigma = \frac{4\pi}{3} G\rho^2 x \tag{244}$$

From (241) and (244) we then obtain:

$$(\sigma/x^2)\int_0^x x^2 \sigma dx = G\rho^2/3 \tag{245}$$

Bearing in mind that $\rho$ is constant, it is evident from (245) that $\sigma$ must also be constant within the system, as may be verified by seeking to solve (245) by substituting arbitrary values of $\sigma$ in terms of $x$. It follows from (245) that:

$$\sigma^2 = G\rho^2 \tag{246}$$

This means that an electron-proton gas subject to predominant self electric and gravitational interactions will have a uniform intrinsic charge density and a uniform mass density related by equation (246). If the gaseous system has a total mass $M$ then it will also have a charge $Q$ given by:

$$Q = G^{\frac{1}{2}} M \tag{247}$$

It may be wondered whether this would apply to a gas composed of hydrogen atoms. Such a gas has closely bound electrons and protons and is neutral in the main. Here there is the probability that there will be a small amount of ionization and the charge-mass ratio of the proton is so very large compared with that given by equation (247) above. Therefore the equation can be satisfied by a very small amount of ionization.

# APPENDIX II

## The Angular Momentum of the Solar System

In the following table the parameters from which the angular momenta of the planets can be estimated are listed. To simplify the data the planetary orbits are deemed to be circular. The data is in earth units, the mass, Earth orbit radius and annual rate of revolution in orbit being taken as reference. The sun, with an estimated angular momentum, is included to facilitate summation. All the angular momenta are in the same direction as all planets rotate in the same sense as the sun rotates about its axis.

| Body | Mass | Orbit radius | Year/rev. | Angular momentum |
|---|---|---|---|---|
| Sun | 332800 | —— | —— | 20 approx. |
| Mercury | 0·05 | 0·387 | 0·24 | 0·03 |
| Venus | 0·82 | 0·723 | 0·62 | 0·69 |
| Earth | 1·00 | 1·00 | 1·00 | 1·00 |
| Mars | 0·11 | 1·52 | 1·88 | 0·135 |
| Jupiter | 317·8 | 5·20 | 11·86 | 724·6 |
| Saturn | 95·2 | 9·54 | 29·46 | 294·1 |
| Uranus | 14·5 | 19·18 | 84·01 | 63·5 |
| Neptune | 17·2 | 30·07 | 165 | 94·3 |
| Pluto | 0·11 | 39·44 | 248 | 0·69 |

The total angular momentum of the solar system may be estimated by summing the last column. It is found to be about 1200 Earth units. The Earth mass is approximately 6·0 $10^{27}$ gm and the Earth's orbital radius is approximately 1·5 $10^{13}$ cm. The Earth rotates in orbit through $2\pi$ radians in a year comprising 3·15 $10^{7}$ sec. Thus one Earth unit of angular momentum is 2·7 $10^{47}$ gm $cm^2$/sec. 1200 such units makes the total angular momentum of the solar system some 3·2 $10^{50}$ gm $cm^2$/sec.

It was stated in the main text when deriving equation (213) that this angular momentum would be substituted for $X$ in:

$$X = 2MR^2w/5 \tag{248}$$

to deduce an estimated value of the sun's angular velocity $w$ before it ejected the planets. The sun's mass $M$ would be very slightly greater than its present value of $1{\cdot}989\ 10^{33}$ gm and its radius would be little different from its present value of $6{\cdot}96\ 10^{10}$ cm. Thus we find that $w$ can be estimated as somewhat less than the value of $8{\cdot}3\ 10^{-5}$ rad/sec obtained by direction substitution of these figures.

# APPENDIX III

## The Fine Structure Constant

In the discussion of moving E-frames in Chapter 9 it was suggested that linear motion of the space lattice implied a reverse motion of free lattice particles at their speed $\frac{1}{2}c$ in orbit in the E-frame. Thus, for a motion through space at 390 km/s (or $\frac{1}{2}c/385$), as measured from the analysis of isotropic cosmic background radiation, we expect to see one free lattice particle in reverse motion per 385 lattice particles in the E-frame.

Consider now the motion of particles as suggested by Fig. 36 in Chapter 7. The lattice particles in E-frame orbit are not changing state during their motion and they are, therefore, in the contracted state intermediate states A and B. When they become free and move through the lattice they are subject to the same cyclic changes of state as other particles. Their $\beta$ factor, or energy as referenced on their rest state, and as discussed by reference to Fig. 36, is that applicable to the speed $\frac{1}{2}c$ or 1·154. Since the radius of a lattice particle is inversely proportional to its energy, its volume in the rest state is $(1{\cdot}154)^3$ times that in its state of motion with the E-frame. This is an increase of 0·54 of the volume of the lattice particle when freed from the E-frame. The base volume is 1/5060 that of a unit cell of the lattice. Accordingly, the effect of linear lattice motion at 390 km/s causes the volume available for continuum on a per E-frame lattice particle basis to diminish by one part in 5060 times 385 divided by 0·54 or by the factor $2{\cdot}8\ 10^{-7}$. This affects the equality of (133), effectively decreasing $d^3$ and thereby effectively increasing the $32\pi$ factor in (134) in the same proportion. In its turn, this increases the value of $\alpha^{-1}$ derived in (157) by 2·8 parts in $10^7$. The resulting evaluation is 137·035953, an important change, especially as $\alpha^{-1}$ is now being measured to accuracy of this order (see footnote on p. 112).