Sir Isaac Newton:
PHILOSOPHIÆ NATURALIS PRINCIPIA MATHEMATICA.
LIBER TERTIUS: DE MUNDI SYSTEMATE.
REGULÆ PHILOSOPHANDI.
REGULA II.
*Ideoque effectuum naturalium ejufdem generis*
*eædem affignandæ funt caufæ, quatenus fieri poteft.*
*Therefore, natural effects of the same kind should*
*be assigned the same causes, as far as possible.*

Please read https://henk-reints.nl/astro/HR-Deflection-of-light-passing-a-mass.pdf .
*It derives how gravitation might actually work.*
Doesn't an electric equivalent of Quilida seem plausible? I'll coin it Quilectra.

Isn't Coulomb's law essentially identical to Newton's law of gravitation? Aren't electric & gravitational forces similar? But electric force can attract/repel & gravity always attracts.

Electric potential: $\Phi_\mathrm{e} = k_\mathrm{e} \frac{Q}{r}$

where: $k_\mathrm{e} = \frac{1}{4\pi\varepsilon_0} = \frac{\mu_0 c^2}{4\pi}$

Gravitational potential at $r_\mathrm{S}$ : $\Phi_\mathrm{g} = -c^2/2$

Newton's regula II. ⇒ we want: $|\Phi_\mathrm{e}| = c^2/2$

It yields a *would-be* radius $r_\mathrm{E}$ : $k_\mathrm{e}\frac{|Q|}{r} = \frac{c^2}{2} \therefore r_\mathrm{E} = \frac{2\frac{\mu_0 c^2}{4\pi}|Q|}{c^2} = \frac{\mu_0|Q|}{2\pi}$

We define: $K \coloneqq \frac{\mu_0}{2\pi}$

and we have[1, p.139–141]: $\mu_0 = \left(1 + \frac{\Delta d}{t_\mathrm{H}}\right) 4\pi \times 10^{-7}$ (H/M = N/A²)

where: $\Delta d =$ ***NOW*** $-$ [2018-01-01]

yielding: $\frac{\Delta d}{t_\mathrm{H}} \approx 5.52 \times 10^{-10}$ (as of 2025-08-08)

which we neglect, so: $K \approx 2 \times 10^{-7}$ m·kg/C²

therefore: $r_\mathrm{E} = Ke \approx 3.204\,353\,26 \times 10^{-26}$ m·kg/C

***which is not a distance,*** we still lack a *specific charge*: $X = x$ C/kg.

We could choose: $X_p \coloneqq \frac{e}{m_p} \quad \therefore K_p \coloneqq \frac{\mu_0 e}{2\pi m_p} \approx 19.157\,666\,29$ m/C

or: $X_e \coloneqq \frac{e}{m_e} \quad \therefore K_e \coloneqq \frac{\mu_0 e}{2\pi m_e} \approx 35\,176.400\,17$ m/C

or[1, p.110]: $X_\mathrm{SC} \coloneqq \frac{e}{m_\mathrm{SC}} \quad \therefore K_\mathrm{SC} \coloneqq \frac{\mu_0 e}{2\pi m_\mathrm{SC}} = \frac{\mu_0 e}{2\pi\sqrt{\frac{ch}{4G}}} = \frac{\mu_0 e}{\pi}\sqrt{\frac{G}{ch}}$

$\approx 1.174\,72 \times 10^{-18}$ m/C

or[1, p.107,110]: $X_\mathrm{u} \coloneqq \frac{e}{\Delta m_\mathrm{u}} \quad \therefore K_\mathrm{u} \coloneqq \frac{\mu_0 e}{2\pi \Delta m_\mathrm{u}} \approx 1.889 \times 10^{+42}$ m/C

In general, we have: $r_{\mathrm{E},x} = K_x|Q|$

For: $Q = e$

we obtain: $r_{\mathrm{E},p} \approx 3.069\,396\,53 \times 10^{-18}$ m $\approx$ 3.1 am

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1 https://henk-reints.nl/astro/HR-Geometry-of-universe-slideshow.pdf as of (2025-07-14)

  

and: $r_{\mathrm{E},e} \approx 5.635\,880\,64 \times 10^{-15}$ m $\approx 5.6$ fm
plus: $r_{\mathrm{E,SC}} \approx 1.882\,11 \times 10^{-37}$ m
as well as: $r_{\mathrm{E,u}} \approx 3.026 \times 10^{+23}$ m $\approx 32$ Mly

In case: $Q = 1$ C
all get a factor of: $6.241\,509\,0745 \times 10^{18}$ ($e$/C).

I have a dream: an electron falls from infinity (where it has zero energy) towards a proton in a further empty universe. At what distance will their mutual velocity equal the speed of light under Newtonian mechanics? We'll ignore gravitation, which is truly negligible. And for now, we'll ignore bremsstrahlung.

Potential energy ($p + e$): $E_\mathrm{p} = \Phi_p q_e = k_\mathrm{e}\dfrac{q_p q_e}{r} = \dfrac{-e^2}{4\pi\varepsilon_0 r} = \dfrac{-\mu_0 e^2 c^2}{4\pi r}$

Total ($p + e$) mass: $M_{pe} = m_p + m_e$

reduced ($p + e$) mass: $\mu_{pe} = \dfrac{m_p m_e}{M_{pe}}$

We have: $E_\mathrm{k} + E_\mathrm{p} = 0$ (ignoring any loss due to Bremsstrahlung)

which renders: $\frac{1}{2}\mu_{pe}c^2 + \dfrac{-\mu_0 e^2 c^2}{4\pi r} = 0$ (***Newtonian*** kinetic energy)

hence: $\frac{1}{2}\mu_{pe}c^2 = \dfrac{\mu_0 e^2 c^2}{4\pi r}$

so: $r_{pe,c} = \dfrac{\mu_0 e^2 c^2}{4\pi\frac{1}{2}\mu_{pe}c^2} = \dfrac{\mu_0 e^2}{2\pi\mu_{pe}} = \dfrac{\mu_0 e^2 (m_p + m_e)}{2\pi m_p m_e}$

for which we find: $r_{pe,c}$ $\approx \mathbf{5.63}8\,950\,04 \times \mathbf{10^{-15}}$ **m**

Above, we found: $r_{\mathrm{E},e} = \dfrac{\mu_0 e^2}{2\pi m_e}$ $\approx \mathbf{5.63}5\,880\,64 \times \mathbf{10^{-15}}$ **m**

This *could* be the "*electric event horizon*" of a proton & electron pair.

Remarkably, the proton mass essentially disappears.

Proton Compton wavelength: $\lambda_{\mathrm{C},p} = \dfrac{h}{m_p c} \approx 1.321\,409\,853\,60 \times 10^{-15}$ m

hence: $\dfrac{\lambda_{\mathrm{C},p}}{r_{\mathrm{E},e}} = \dfrac{h}{m_p c}\dfrac{\pi m_e c}{\alpha h} = \dfrac{\pi m_e}{\alpha m_p}$ $\approx 0.234\,463\,775\,55$

and: $\dfrac{r_{\mathrm{E},e}}{\lambda_{\mathrm{C},p}} = \dfrac{\alpha m_p}{\pi m_e}$ $\approx 4.265\,051\,169\,08$

In reality, the accelerating electron *does* emit Bremsstrahlung and energy, which can only reduce the acceleration, so it'll actually dive significantly deeper before achieving $c$ .

We have: $F = k_\mathrm{e}\dfrac{Q_1 Q_2}{r^2} = G\dfrac{k_\mathrm{e}}{G}\dfrac{Q_1 Q_2}{r^2} = G\dfrac{\left(Q_1\sqrt{k_\mathrm{e}/G}\right)\left(Q_2\sqrt{k_\mathrm{e}/G}\right)}{r^2}$

& we define: $k_\mathrm{g} := \sqrt{\dfrac{k_\mathrm{e}}{G}} = \sqrt{\dfrac{1}{4\pi\varepsilon_0 G}} = \sqrt{\dfrac{1}{4\pi\frac{e^2}{2\alpha hc}G}} = \dfrac{1}{e}\sqrt{\dfrac{\alpha hc}{2\pi G}} \approx 1.160\,427 \times 10^{10}$ kg/C

This is a fundamental constant of nature that converts any charge to an equivalent *electric mass*. It is the mass yielding a gravitational pull equal to the electric force. An elementary charge then "weighs" $\sqrt{\alpha\hbar c/G} \approx 1.859\,209 \times 10^{-9}$ kg $\approx 1.86$ µg.

Grav. Schwarzschild radius: $r_\mathrm{S} = \dfrac{2GM}{c^2}$

Apply Regula II.:
*electric Schwarzschild radius*: $r_{\mathrm{S,e}} = \dfrac{2Gk_\mathrm{g}Q}{c^2}$

  

*electric gravitational constant*: $G_\mathrm{e} \coloneqq Gk_\mathrm{g} = \frac{1}{e}\sqrt{\frac{\alpha hcG}{2\pi}} \approx 0.774\,5038\ \mathrm{m^3/s^2C}$

and we obtain: $r_\mathrm{S,e} = \frac{2G_\mathrm{e}Q}{c^2}$

with which we can define a dimensionless radius: $\rho_\mathrm{e} \coloneqq \frac{r}{r_\mathrm{S,e}}$

To me, this seems way more fundamental that what this very document starts with. $k_\mathrm{g}$ should be used instead of $X_x$ .

A charge in the field around some central charge can be multiplied by $k_\mathrm{g}$ , rendering the

*electric gravitational potential*: $\Phi_\mathrm{e,g} = G\frac{k_\mathrm{g}Q}{r} = G_\mathrm{e}\frac{Q}{r}, \quad E = \Phi_\mathrm{e,g}k_\mathrm{g}Q$

For an elementary charge: $r_{\mathrm{S,e},e} \approx 2.761\,36 \times 10^{-36}$ m
$\approx 0.170\,85\ \ell_\mathrm{P}$

For my new mass unit[1]: $\Delta m_\mathrm{u} = hH/c^2$ ,
we obtain: $r_{\mathrm{S},\Delta m_\mathrm{u}} = 2GhH/c^4 \approx 2.520 \times 10^{-95}$ m
Ratio: $r_{\mathrm{S,e},e}/r_{\mathrm{S},\Delta m_\mathrm{u}} \approx 1.096 \times 10^{59}$

Electric Schw. radius of $Q = 1$ C: $r_\mathrm{S,e} = \frac{2G_\mathrm{e}(1\ \mathrm{coulomb})}{c^2} \approx 1.723\,50 \times 10^{-17}$ m
grav. Schw. radius of $M = 1$ kg: $r_\mathrm{S} = \frac{2G(1\ \mathrm{kg})}{c^2} \approx 1.485\,23 \times 10^{-27}$ m
ratio: $1.160\,427 \times 10^{10}$ *Deja vu!*

Although this ratio *is* dimensionless, it *does* depend on kilogram & coulomb. When using S.I. units, the linear spatial requirement of electricity would be $11\frac{1}{2}$ billion (NL: miljard) times larger than that of gravitation. But, due to Coulomb repulsion, large isolated charges will simply exp**lode!** Very plausibly, there exist no electric black holes. This implies all of the above is actually senseless (except Quilectra?), but did it render some insight?

I calculated[1] the total mass of the universe as $8.77 \times 10^{52}$ kg by equating it's Schwarzschild radius to the Hubble distance. Substantiation: if one sticks to the Cosmological Principle, there can be just one characteristic distance. Otherwise, things would have different environments within the smallest, between them, or outside the largest, thus violating the homogeneity saying the universe essentially is the same everywhere. This should especially apply to the laws of nature. The electric equivalent yields:

$$D_\mathrm{H} = \frac{2G_\mathrm{e}Q_\mathrm{U}}{c^2} = \frac{2Q_\mathrm{U}}{ec^2}\sqrt{\frac{\alpha hcG}{2\pi}} \therefore Q_\mathrm{U} = ec^2D_\mathrm{H}\sqrt{\frac{\pi}{2\alpha hcG}} \therefore \frac{Q_\mathrm{U}}{e} = c^3t_\mathrm{H}\sqrt{\frac{\pi}{2\alpha hcG}} = \boldsymbol{\sqrt{\frac{\pi c^5}{2\alpha hG}}/H}$$

With $H = 71$ km/s/Mpc, we obtain: $Q_\mathrm{U}/e \approx 4.72 \times 10^{61} \therefore Q_\mathrm{U} \approx 7.56 \times 10^{42}$ C. It would yield an electric Schwarzschild radius equal to the Hubble distance. Of course it merely is a pseudo charge, a calculated value that does not even match the no. of nucleons in the universe: $N_\mathrm{U} \approx 5.24 \times 10^{79}$. I have no idea about what to do with it, but isn't it a nice derivation?

## *Coulomb explosion*:

The gravitational potential energy of a homogeneous sphere[2] equals: $E_\mathrm{p,g} = \frac{-3GM^2}{5R}$

[2] https://scienceworld.wolfram.com/physics/SphereGravitationalPotentialEnergy.html

  

Its electric equivalent must be: $E_{\mathrm{p,e}} = \frac{3k_\mathrm{e}Q^2}{5R} = \frac{3Q^2}{20\pi\varepsilon_0 R} = \frac{3\alpha hc}{10\pi e^2}\frac{Q^2}{R}$

Sign flip: electric force between equally signed charges is repulsive.

Suppose this sphere consists of protons at a density such that the strong interaction has no effect. A proton's diameter narrowly exceeds its Compton wavelength, which we can can taaaaah rattah tah tah taaah taaah rah tah teeh tah teeeh teeeasily calculate.

Which we'll do: $r_p = \frac{\lambda_{\mathrm{C},p}}{2} = \frac{h}{2m_p c}$

& we avoid strong interaction: $d_p = 3r_p = \frac{3h}{2m_p c}$

Effective proton volume: $V_p = \frac{4\pi}{3}d_p^3 = \frac{4\pi}{3}\frac{27h^3}{8m_p^3c^3} = \frac{9\pi h^3}{2m_p^3c^3}$

Total volume if #protons $= N$: $V_p^* = \frac{9\pi N h^3}{2m_p^3c^3}$ (under isovolumetric deformation of $V_p$)

which yields: $R = \sqrt[3]{\frac{3V_p^*}{4\pi}} = \sqrt[3]{\frac{27Nh^3}{8m_p^3c^3}} = \frac{3h\sqrt[3]{N}}{2m_p c}$

as well as: $Q = Ne$

so we obtain: $E_{\mathrm{p,e}} = \frac{3\alpha hc}{10\pi e^2}\frac{Q^2}{R} = \frac{3\alpha hc}{10\pi}\frac{2m_p cN^2}{3h\sqrt[3]{N}} = \frac{\alpha m_p c^2 N^{5/3}}{5\pi}$

Per proton, this is: $E_{\mathrm{p,e}}^* = \frac{\alpha m_p c^2 N^{2/3}}{5\pi}$

A sort of tipping point would be: $N^{2/3}\alpha/5\pi = 1 \therefore N = (5\pi/\alpha)^{3/2} \approx \mathbf{100\,000}$.

Yes! Merely $100\,000$ protons packed to get her but still out of reach of the strong nuclear force suffice for a potential energy equal to their rest energy!

The **entire cosmos** contains[1]: $N_\mathrm{U} \approx 5.24 \times 10^{79}$ nucleons.

Would all of them be protons at said density,

they would require: $\sim\mathbf{10^{40}}$ **J/$p$** $\asymp 1.1 \times 10^{23}$ kg/$p$ ($m = E/c^2$)

or, in total: $\sim\mathbf{5 \times 10^{119}}$ **J** $\asymp 5.7 \times 10^{102}$ kg

$\approx 6.5 \times 10^{49} M_\mathrm{U}$

This last magnitude equals: $\frac{E_{\mathrm{p,e}}^*}{m_p c^2} = \frac{\alpha N_\mathrm{U}^{2/3}}{5\pi}$

This scenario is of course impossible, these amounts of energy are ~~rather silly~~ completely ridiculous. Luckily, there are just as many electrons as protons, totally compensating it.

It all adds up to a very Big Bang.

Image by Pablo Carlos Budassi (CC BY-SA 4.0)
https://www.sciencemusings.com/it-all-adds-up-to-a-very-big-bang/