CODATA history of the *fine-structure constant*:

year	value	uncertainty	low bound	high bound	change	overlap?
1998	**7.297352533** e-3	2.7e-11	7.297352506 e-3	7.297352560 e-3		
2002	**7.29735256**8 e-3	2.4e-11	7.297352**544** e-3	7.297352592 e-3	+4e-11	yes
2006	**7.2973525376** e-3	5.0e-12	7.2973525326 e-3	7.2973525**426** e-3	-3e-11	**NO**
2010	**7.297352569**8 e-3	2.4e-12	7.2973525**674** e-3	7.2973525722 e-3	+3e-11	**NO**
2014	**7.297352566**4 e-3	1.7e-12	7.2973525647 e-3	7.29735256**81** e-3	-3e-12	yes
2018	**7.297352569**3 e-3	1.1e-12	7.29735256**82** e-3	7.2973525704 e-3	+3e-12	**NO**
2022	**7.2973525643** e-3	1.1e-12	7.2973525632 e-3	7.29735256**54** e-3	-5e-12	**NO**
HR	**7.29735256**944e-3	1.1e-12	7.29735256834e-3	7.29735257055e-3		

To me, it seems ***very*** strange
that succeeding CODATA values
do ***not*** have overlapping tolerances!

Doesn't this ***prove*** that the given
uncertainties are ***way*** too optimistic?

I would easily apply a factor of 10 (ten) to the given uncertainty.

Physical constants:

SI-2019:

$c := 299\,792\,458$ m/s

$e := 1.602\,176\,634 \quad \times 10^{-19}$ C

$h := 6.626\,070\,15 \times 10^{-34}$ J·s

CODATA (index 2019 instead of 2018 because that's when S.I. Brochure 9 became effective):

$\mu_{0,<2019} := 4\pi \times 10^{-7}$ H/m

$\approx 1.256\,637\,06\mathbf{1}\,\mathbf{4}35\,9172 \times 10^{-6}$ H/m

$\mu_{0,2019} = 1.256\,637\,06\mathbf{2}\,\mathbf{12} \times 10^{-6} \pm 1.9 \times 10^{-16}$ H/m

$\mu_{0,2022} = 1.256\,637\,06\mathbf{1}\,\mathbf{27} \times 10^{-6} \pm 2.0 \times 10^{-16}$ H/m

$\alpha_{2019} = 7.297\,352\,5693 \times 10^{-3} \pm 1.1 \times 10^{-12}$

$\alpha_{2022} = 7.297\,352\,5643 \times 10^{-3} \pm 1.1 \times 10^{-12}$

I have **ZERO CONFIDENCE** in the **CODATA 2022** value of $\boldsymbol{\mu_0}$, see https://henk-reints.nl/astro/HR-Geometry-of-universe-slideshow-20250714T160721Z.pdf, pp.139-141.

In that document, I conclude (essentially from observed phenomena!) that both $\boldsymbol{\mu_0}$ and $\boldsymbol{h}$ must be ***proportional to the Hubble time*** (**see appendix @p.7**) and I also derive that $\boldsymbol{\mu_{0,\mathrm{HR}}} := (\boldsymbol{\mu_{0,2019}}$ (fixed to 2018-01-01) plus $0.15 \times$ its tolerance) would best agree with the measured cosmic expansion. It would apply to 2018-01-01.

Its value would be:

$$\boldsymbol{\mu_{0,\mathrm{HR}} \approx 1.256\,637\,062\,15 \times 10^{-6} \pm 1.9 \times 10^{-16}}\ \mathrm{kg\ m\ s^{-2}\ A^{-2}}$$

We have:

$$\boldsymbol{\alpha = \frac{ce^2}{2}\frac{\mu_0}{h}}$$

(not $\propto \boldsymbol{t_\mathrm{H}}$ since both $\boldsymbol{\mu_0}$ & $\boldsymbol{h}$ are).

Fixing both $\boldsymbol{\mu_0}$ & $\boldsymbol{h}$ to the same date of measurement (which is a *PRESUMPTION* of mine!), we obtain:

$$(\mu_0/h)_\mathrm{HR} \approx 1.896\,504\,313\,57 \times 10^{27} \pm 2.9 \times 10^{17}\ \mathrm{/m/s/A^2}$$

$$\alpha_\mathrm{HR} \approx 7.297\,352\,569\,44 \times 10^{-3} \pm 1.1 \times 10^{-12}$$

$$1/\alpha_\mathrm{HR} \approx 137.035\,999\,081 \pm 2.1 \times 10^{-8}$$

Both $\boldsymbol{\mu_0/h}$ and $\boldsymbol{\alpha}$ would be time independent true constants of nature and $\boldsymbol{\mu_{0,\mathrm{HR}}}$ & $\boldsymbol{\alpha_\mathrm{HR}}$ would be the **best approximations** currently achievable.

Correctly measuring μ_0 & h without any confirmation bias or wishful thinking over a longer period of time would accurately reveal their growth rate, hence the *Hubble constant* & the *age of the universe*!

$$H_0 = \mathbf{71}\ \text{km/s/Mpc} \qquad \approx 2.301 \times 10^{-18}\ \text{/s}$$

$$D_\mathrm{H} = c/H_0 \qquad \approx 1.303 \times 10^{26}\ \text{m}$$

$$\approx 13.77 \times 10^{9}\ \text{ly}$$

$$t_{\mathrm{H}0} = c/H_0 \quad \approx 434\,602\,476\,263\,984\,770\ \text{s}$$

$$+\,\textit{Julian year} \qquad \mathbf{3}1\,557\,600\ \text{s}$$

$$t_{\mathrm{H}1} \qquad 434\,602\,476\,294\,542\,330\ \text{s}$$

11^{th} t_H digit changes by ~ 3 every year!

Relative change of $x \propto t_\mathrm{H}$: 6.9×10^{-11} /year.

Measurable!(?)

Proportionality to the *Hubble time* would simply mean:

$$\boldsymbol{\mu_0 = Я t_{\mathrm{H}}} \quad \therefore Я = \frac{d\mu_0}{dt_{\mathrm{H}}} \quad = \text{measurable!}$$

(*Я* is the Russian capital letter *Ya*; I had to choose something
& why should I restrict myself to the Latin & *Ελληνικά* alphabets?)

Via: $$\alpha = \frac{ce^2\mu_0}{2h}$$

we simply find: $$h = \frac{ce^2\mu_0}{2\alpha} = \frac{ce^2}{2\alpha} Я t_{\mathrm{H}}$$

This proportionality implies the B.I.P.M.
has made a very serious mistake
by fixing Planck's constant to an exact value,
since it simply is not a true constant over time!

See: https://henk-reints.nl/astro/HR-Geometry-of-universe-slideshow-20250714T160721Z.pdf,
pp.80,91,92,95,106,107,139-141.

Instead, they could (should?) define the **kilogram** as an **exact number** of **proton masses**.

(The proton is the heaviest stable particle we know & CODATA gives $\boldsymbol{m_p}$ more precisely than $\boldsymbol{m_e}$).

Averaging CODATA of 2014, 2018 & 2022

(I wouldn't stick to just one value & I have little faith in CODATA 2022, see p.141 of the link just given)

renders: $m_p \approx 1.672\,621\,915\,880\ \mathrm{kg}$

so I would define:

$$\mathbf{1\ kg \coloneqq 5.978\,637\,434\,473 \times 10^{26}} \boldsymbol{m_p}$$

and return Planck's constant to the realm of measured quantities.

Appendix

If you want to stick to the
Cosmological Principle
(the universe essentially is homogeneous & isotropic)
you cannot disagree with:

There can be one and only one distance that's characteristic for the entire cosmos.

Proof by contradiction:

Would there be more than one, one could get beyond the smallest before reaching the largest,
implying the cosmos would there differ from within the smallest,
thus breaking the homogeneity,
contradicting the Cosmetical Principle
(isn't the cosmos a beauty?).

Whether the cosmos is a Black Hole or not[1],

we can at least *assign*

a ***Schwarzschild distance***

to its total *mass* (incl. its total E/c^2).

According to the above,

this *must* than exactly

equal the ***Hubble distance***:

$$\frac{2GM_{\mathrm{U}}}{c^2} = D_{\mathrm{H}} = ct_{\mathrm{H}}$$

$$\therefore G = \frac{c^3}{2M_{\mathrm{U}}} t_{\mathrm{H}}$$

[1] which it certainly is **not**, see https://henk-reints.nl/astro/HR-Geometry-of-universe-slideshow-20250714T160721Z.pdf

Definition: ***truly constant*** :=
same value ***everywhere*** AND (in particular) ***always***.

If we ***PRESUME*** c & M_{U}
truly constant, then

the ***gravitational constant*** is ***proportional*** to the ***Hubble time***!

Wouldn't this easily explain how the Big Bang could occur at all, *against the immense gravitational pull* of all mass in the universe?

By then, there practically was ***ZERO GRAVITY***!

$$G = \frac{c^3}{2M_{\mathrm{U}}} t_{\mathrm{H}} \quad \therefore M_{\mathrm{U}} = \frac{c^3}{2G} t_{\mathrm{H}}$$

With: $H = 71$ km/s/Mpc, this yields:

$$M_{\mathrm{U}} \approx 8.77 \times 10^{52}\ \mathrm{kg}$$

#atoms: $N_{\mathrm{U}} \approx M_{\mathrm{U}}/1.008\ \mathrm{amu} \approx 5.24 \times 10^{79}$

Entire cosmos, contracted to a ball of close-packed neutronium,
with **current value of G**:

```
neutronRadius             : +8.4e-16                m                  (see https://henk-reints.nl/HR-Existance-postulate.pdf)
neutronVolume             : +2.4827127095377135e-45 m^3
numberOfNeutrons          : +5.24e+79
totalVolume               : +1.7568882339317536e+35 m^3  = +5.248e+1   au^3
totalRadius               : +347444287              km   = +2.323      au
neutronMass               : +1.67492750056e-27      kg   = +939.565    MeV/c^2
totalMass                 : +8.7766201029344e+52    kg        (calc'd with neutronMass instead of amu)
totalPotentialEnergy      : -8.87823016118516e+83   J    = -3*G*M^2/5R
specificPotentialEnergy   : -1.0115773563238526e+31 J/kg
potEnergyPerNeutron       : -16943.187330506032     J    = -1.058e+17  MeV/c^2
potEnergyPerNeutRestEnergy: -1.126e+14
```

Mean gravitational binding energy per neutron: $\sim 10^{14} m_n c^2$

Planck mass:

(I firmly & consequently refuse to abuse $\hbar$ for it)

$$m_{\mathrm{P}} = \sqrt{hc/G}$$

IF we consider this a truly constant quantity

(conservation of mass, incl. E/c^2),

then $\boldsymbol{h/G}$ must be ***truly constant***.

Therefore: $\boldsymbol{h \propto t_{\mathrm{H}}}$

See https://henk-reints.nl/astro/HR-Geometry-of-universe-slideshow-20250714T160721Z.pdf

pp.106–112 for more details & consequences hereof and

on pp.136 & 139–141

I show: $\boldsymbol{\mu_0 \propto t_{\mathrm{H}}}$

confirmed(?) by measurements!