Appendix — Photon-Capacitor Analogy and the Emergence of $E = h\nu$

1 Physical picture and working assumptions

A single photon is modelled, in VAM, as a one-turn helical vortex loop of circumference λ and tangential swirl speed C_e.

Treat the loop as a parallel-plate capacitor with

- effective plate area $A = \lambda^2$ (square of the spatial period),
- effective plate separation $d = \frac{1}{2}\lambda$ (half-pitch of the helix).

Classical electrodynamics (SI) supplies the capacitance formula

$$C = \varepsilon_0 \frac{A}{d}.$$

All symbols follow the constant glossary used throughout the VAM papers.

2 Capacitance of the photon loop

Using $A = \lambda^2$ and $d = \frac{1}{2}\lambda$ gives

$$\begin{aligned} C &= \varepsilon_0 \frac{\lambda^2}{\frac{1}{2}\lambda} \\ &= 2\,\varepsilon_0\,\lambda. \end{aligned} \tag{2.1}$$

3 Insert the wave relation

The usual relation between frequency and wavelength in the æther swirl field is

$$\lambda = \frac{C_e}{\nu}. \tag{3.1}$$

So the capacitance becomes

$$C = 2\,\varepsilon_0\,\frac{C_e}{\nu}. \tag{3.2}$$

4 Electrostatic energy stored in the loop

For a charge Q distributed across the two plates, the stored energy is

$$E = \frac{Q^2}{2C} = \frac{Q^2}{4\,\varepsilon_0\,C_e}\,\nu. \tag{4.1}$$

Setting $Q = e$ (elementary charge) ties the energy scale to a fundamental quantum.

5 Identification with the Planck relation

Comparing (4.1) with the quantum postulate $E = h\nu$ singles out the bracket as Planck's constant:

$$h \equiv \frac{e^2}{4\,\varepsilon_0\,C_e}. \tag{5.1}$$

Numerically, with $C_e = 1.09384563 \times 10^6\,\mathrm{m\,s^{-1}}$, this yields

$$h_{\mathrm{VAM}} = 6.615 \times 10^{-34}\,\mathrm{J\,s},$$

within 0.2% of the CODATA value $6.626 \times 10^{-34}\,\mathrm{J\,s}$.

Key point — dimensional inevitability: once C_e is fixed by the fine-structure relation $\alpha = 2C_e/c$, no further tuning is possible; h follows automatically.

6 Cross-check with the vortex-tension formula

Section 2 of the constants appendix derived a second expression

$$h = \frac{4\pi F_{\max} r_c^2}{C_e}, \tag{1}$$

from vortex tension $F_{\max}$ and core radius r_c. Agreement between the two routes is a stringent self-consistency test:

$$\frac{e^2}{4\varepsilon_0} \Big/ C_e = \frac{4\pi F_{\max} r_c^2}{C_e}$$
$$\Longrightarrow\; e^2 = 16\pi\varepsilon_0 F_{\max} r_c^2.$$

This links the mechanical æther parameters $(F_{\max}, r_c)$ to the electromagnetic charge scale e.

7 Dimensional and physical interpretation

The numerator e^2 is a flux of action per unit permittivity; dividing by a speed converts it to pure action (units of J s).

Planck's constant therefore appears as one quantum of momentum-flux circulation in the æther.

8 Consequences and experimental hooks

1. Parameter inter-lock: independent measurements of e, ε_0, C_e *must* reproduce the numeric h. Any deviation falsifies VAM.

2. Photon–electron coupling: resonance occurs when the photon swirl radius $R = C_e/(2\pi\nu)$ scaled by $1/\alpha$ matches the Bohr radius a_0—explaining the peak excitation probability of the hydrogen 1s state.

3. Casimir regularisation: inserting h from (5.1) into the standard Lifshitz integral shows how the æther's maximum tension suppresses high-k vacuum modes.

9 Summary box

$$\boxed{E = h\nu, \qquad h = \frac{e^2}{4\varepsilon_0 C_e} = \frac{4\pi F_{\max} r_c^2}{C_e}}$$

Two independent microscopic routes, one electromagnetic and one purely mechanical, converge on the same Planck constant. This dual derivation is a cornerstone consistency check of the Vortex Æther Model.