The Josephson Effect in the Aether Physics Model Using Quantum Measurement Units

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Abstract

We present a Quantum Measurement Units (QMU) formulation of the Josephson effect within the Aether Physics Model (APM). Using ledger identities on the QMU basis (m_{e}, λ_C, F_q, e^2, ${e_{\mathrm{emax}}}^2$), we derive compact expressions for the flux quantum and Josephson constant,

$$\boxed{\frac{\Phi_\star}{\mathrm{ccf}} = \frac{\mathrm{mflx}}{2}}, \qquad \boxed{K_J = \frac{2}{\mathrm{ccf}\,\mathrm{mflx}}},$$

with the charge conversion factor defined by $\mathrm{ccf} \equiv {e_{\mathrm{emax}}}^2/e$ [8]. We express the junction's characteristic magnetic reluctance in a purely QMU, ledger-tight form by eliminating SI permittivity in favor of A_u, starting from a three-force symmetry and QMU dimensional analysis that selects a scaling $\propto \epsilon_0^2 G/\mathrm{curl}$,

$$\mathcal{R}_J = \gamma_J \frac{16\pi^2\, G}{{A_u}^2\,\mathrm{curl}} = \gamma_J \frac{G}{A_u\, k_C\,\mathrm{curl}} = \gamma_J \frac{16\pi^2\, G}{A_u\, {F_q}^2 {\lambda_C}^2},$$

with γ_J a geometry factor and $A_u \cdot \mathrm{curl} = {F_q}^2{\lambda_C}^2$. Interpreted physically, Josephson transport measures the Aether's *torsion susceptibility*, i.e. the conversion of unified Aether forcing into phase transport, modulated by the torsional stiffness curl.

1 Standard-model recap (context only)

The Josephson effect arises when two superconductors are weakly coupled through a thin barrier (tunnel junction, microbridge, or weak link). The macroscopic quantum phase difference ϕ across the barrier drives a dissipationless supercurrent,

$$I = I_c \sin\phi, \tag{1.1}$$

$$\dot{\phi} = K_J\, \mathcal{E}, \tag{1.2}$$

where I_c is the critical current and $\mathcal{E}$ is the applied electromotive drive. In standard metrology, K_J is fixed by the inverse of the historical flux quantum. Classic references include Josephson's 1962 letter and standard texts [1, 2, 3, 4]. Our objective here is not to re-derive BCS physics, but to *translate* Josephson phenomena into the QMU ledger so that unification in APM is manifest and unit-consistent.

Definition. Throughout, $\mathcal{E}$ denotes the *QMU electromotive drive*. No SI units are introduced; all quantities are expressed on the QMU basis.

2 QMU ledger and unit sheet essentials

We adopt the APM/QMU ledger identities

$$c \;=\; \lambda_C F_q, \qquad A_u \cdot \mathrm{curl} \;=\; {F_q}^2 {\lambda_C}^2 \;=\; \mathrm{rson}\, {\lambda_C}^2, \qquad \mathrm{mflx} \;=\; \frac{m_\mathrm{e}\, {\lambda_C}^2 F_q}{{e_\mathrm{emax}}^2}. \tag{2.1}$$

The QMU units relevant to Josephson physics are summarized in Table 1. The permittivity ptty is not used explicitly until Sec. 7, where it is eliminated in favor of A_u.

Unit name	Symbol	QMU expression
Magnetic flux	mflx	$\mathrm{mflx} = \dfrac{m_\mathrm{e}\, {\lambda_C}^2 F_q}{{e_\mathrm{emax}}^2}$
Inductance	indc	$\mathrm{indc} = \dfrac{m_\mathrm{e}\, {\lambda_C}^2}{{e_\mathrm{emax}}^2}$
Permeability	perm	$\mathrm{perm} = \dfrac{m_\mathrm{e}\, \lambda_C}{{e_\mathrm{emax}}^2}$
Permittivity	ptty	(via $A_u = 16\pi^2 k_C$, see Sec. 7)
Curl (torsion stiffness)	curl	$\mathrm{curl} = \dfrac{{e_\mathrm{emax}}^2}{m_\mathrm{e}\, {\lambda_C}^4}$
Magnetic reluctance	mrlc	$\mathrm{mrlc} = \dfrac{{e_\mathrm{emax}}^2}{m_\mathrm{e}\, {\lambda_C}^2}$
Resonance	rson	$\mathrm{rson} = {F_q}^2$

Table 1: Selected QMU units used in the Josephson analysis.

3 Side-by-side mapping: standard vs. QMU forms

A compact "Rosetta" for the two most visible metrology constants is:

Quantity	Standard (historical)	QMU (charge basis converted)
Flux quantum	$\Phi_\star$	$\dfrac{\Phi_\star}{\mathrm{ccf}} = \dfrac{\mathrm{mflx}}{2}$
Josephson constant	$K_J = \Phi_\star^{-1}$	$K_J = \dfrac{2}{\mathrm{ccf}\,\mathrm{mflx}}$

Here $\mathrm{ccf} \equiv {e_\mathrm{emax}}^2/e$ converts from the historical e-based charge to the QMU ${e_\mathrm{emax}}^2$-based charge [8].

4 Flux quantization and the QMU flux quantum

From the ledger identity

$$m_\mathrm{e}\, {\lambda_C}^2 F_q \;=\; {e_\mathrm{emax}}^2\, \mathrm{mflx}, \tag{4.1}$$

the canonical action scale $m_\mathrm{e}\, {\lambda_C}^2 F_q$ equals ${e_\mathrm{emax}}^2$ times the QMU flux unit.

Pedagogical mapping from the standard form. Starting from the standard $\Phi_0 = h/(2e)$ (contextual, not used numerically here), the QMU charge basis replaces e by ${e_{\text{emax}}}^2$ using $\text{ccf} = {e_{\text{emax}}}^2/e$ [8]. Thus the historical flux quantum expressed in QMU is

$$\frac{\Phi_\star}{\text{ccf}} \;=\; \frac{1}{\text{ccf}}\,\frac{h}{2e} \quad\longrightarrow\quad \frac{\text{mflx}}{2},$$

because h reduces on the ledger to $m_{\text{e}}\,{\lambda_C}^2 F_q$ and then to ${e_{\text{emax}}}^2\,\text{mflx}$ via (4.1). We therefore record the compact mapping

$$\boxed{\frac{\Phi_\star}{\text{ccf}} \;=\; \frac{\text{mflx}}{2}}. \tag{4.2}$$

5 Josephson constant in QMU

Because the AC Josephson proportionality is the inverse of the historical flux quantum,

$$\boxed{K_J \;=\; \frac{1}{\Phi_{\text{std}}} \;=\; \frac{2}{\text{ccf}\,\text{mflx}}\,,} \tag{5.1}$$

consistent with $\text{ccf} = {e_{\text{emax}}}^2/e$ [8].

6 DC and AC Josephson modes in QMU

DC mode. With zero average emf across the junction, a steady phase offset ϕ supports

$$I \;=\; I_c\,\sin\phi. \tag{6.1}$$

In QMU, I is a transport rate of distributed charge modulated by the junction's aether-rotational coupling (curl) and its magnetic reluctance (Sec. 7). The critical current is set by the balance between curl-enabled phase rigidity and geometry γ_J.

AC mode. For a constant QMU emf $\mathcal{E}$,

$$\dot{\phi} \;=\; K_J\,\mathcal{E} \;=\; \frac{2}{\text{ccf}\,\text{mflx}}\,\mathcal{E}. \tag{6.2}$$

Small-signal example (illustrative). Linearizing (6.1) near a static phase ϕ_0 gives $\delta I \approx I_c\cos\phi_0\,\delta\phi$. Driving with a small QMU emf $\delta\mathcal{E}$ yields $\delta\dot{\phi} = K_J\,\delta\mathcal{E}$. Eliminating $\delta\phi$ for a harmonic drive $\delta\mathcal{E} \propto e^{i\omega t}$ produces the transfer magnitude

$$\left|\frac{\delta I}{\delta\mathcal{E}}\right| \;=\; \frac{I_c\cos\phi_0}{\omega}\,K_J \;=\; \frac{I_c\cos\phi_0}{\omega}\,\frac{2}{\text{ccf}\,\text{mflx}},$$

explicitly showing how the measurable slope scales with the QMU flux unit.

7 Junction reluctance in purely QMU form

To keep the formulation QMU-only (no SI ϵ_0), eliminate ϵ_0 via A_u:

$$A_u \;=\; 16\pi^2\,k_C, \qquad k_C = \frac{1}{4\pi\,\epsilon_0} \;\Rightarrow\; \epsilon_0 = \frac{4\pi}{A_u}, \qquad \epsilon_0^2 = \frac{16\pi^2}{{A_u}^2}. \tag{7.1}$$

Formal mini-derivation of the scaling

We seek a reluctance-like transport factor $\mathcal{R}_J$ that (i) encodes all three force constants (unified forcing), (ii) is inversely proportional to the torsional stiffness (curl), and (iii) is ledger-dimensional on the QMU basis.

Dimensional ledger (exponent vectors). Work on the basis $(m_{\mathrm{e}}, \lambda_C, F_q, {e_{\mathrm{emax}}}^2)$. From $A_u \cdot \mathrm{curl} = {F_q}^2 {\lambda_C}^2$ and $\mathrm{curl} = {e_{\mathrm{emax}}}^2/(m_{\mathrm{e}}\,\lambda_C)$ we obtain

$$\begin{aligned} G &\sim {m_{\mathrm{e}}}^{-1}\,{\lambda_C}^{3}\,{F_q}^{2}, \\ \mathrm{curl} &\sim {e_{\mathrm{emax}}}^{2}\,{m_{\mathrm{e}}}^{-1}\,{\lambda_C}^{-1}, \\ A_u &\sim {e_{\mathrm{emax}}}^{-2}\,{m_{\mathrm{e}}}^{+1}\,{\lambda_C}^{+3}\,{F_q}^{+2}, \\ k_C &\sim A_u \quad (\text{since } A_u = 16\pi^2 k_C), \\ \epsilon_0 &\sim {e_{\mathrm{emax}}}^{2}\,{m_{\mathrm{e}}}^{-1}\,{\lambda_C}^{-3}\,{F_q}^{-2}. \end{aligned}$$

A minimal three-force, torsion-modulated scalar is therefore

$$\frac{{\epsilon_0}^2\,G}{\mathrm{curl}} \sim \Big({e_{\mathrm{emax}}}^{4}\,{m_{\mathrm{e}}}^{-2}\,{\lambda_C}^{-6}\,{F_q}^{-4}\Big)\cdot\Big({m_{\mathrm{e}}}^{-1}\,{\lambda_C}^{+3}\,{F_q}^{+2}\Big)\cdot\Big({e_{\mathrm{emax}}}^{2}\,{m_{\mathrm{e}}}^{-1}\,{\lambda_C}^{-1}\Big)^{-1} = {e_{\mathrm{emax}}}^{2}\,{m_{\mathrm{e}}}^{-2}\,{\lambda_C}^{-2}\,{F_q}^{-2}.$$

Using ${e_{\mathrm{emax}}}^2 = \dfrac{m_{\mathrm{e}}\,{\lambda_C}^2\,F_q}{\mathrm{mflx}}$, this collapses to the compact ledger form

$$\boxed{\frac{{\epsilon_0}^2 G}{\mathrm{curl}} = \frac{1}{m_{\mathrm{e}}\,F_q\,\mathrm{mflx}}} \tag{7.2}$$

which is equivalent to the QMU-only forms:

$$\frac{{\epsilon_0}^2 G}{\mathrm{curl}} = \frac{16\pi^2 G}{{A_u}^2 \mathrm{curl}} \tag{7.3}$$

$$= \frac{G}{A_u\,k_C\,\mathrm{curl}} \tag{7.4}$$

$$= \frac{16\pi^2 G}{A_u\,{F_q}^2{\lambda_C}^2}, \tag{7.5}$$

using $A_u\,\mathrm{curl} = {F_q}^2{\lambda_C}^2$. Multiplying by γ_J defines the Josephson reluctance

$$\mathcal{R}_J = \gamma_J\,\frac{16\pi^2\,G}{{A_u}^2\,\mathrm{curl}} = \gamma_J\,\frac{G}{A_u\,k_C\,\mathrm{curl}}, \tag{7.6}$$

with the alternative compact form

$$\mathcal{R}_J = \gamma_J\,\frac{16\pi^2\,G}{A_u\,{F_q}^2{\lambda_C}^2} = \gamma_J\,\frac{16\pi^2\,G}{A_u\,\mathrm{rson}\,{\lambda_C}^2}. \tag{7.7}$$

Remark. Equations (7.6)–(7.7) show that $\mathcal{R}_J$ expresses a symmetric three-force structure: G (gravitational), k_C (electrostatic), and A_u (magnetic), braided through the torsional stiffness curl in a single QMU transport quantity.

8 Unified force interpretation and the role of curl

In APM, the three inverse-square force constants are

$$G \quad \text{(gravitational)}, \qquad k_C \quad \text{(electrostatic)}, \qquad A_u \quad \text{(magnetic)},$$

and they share a common substrate scaling, *Gforce* (the unified force of the Aether prior to projection) [7]. The Josephson junction is a rare system where quantum coherence makes this common origin *directly measurable*.

Curl as torsion stiffness. The ledger identity $A_u\,\mathrm{curl} = {F_q}^2{\lambda_C}^2$ shows that curl is the operator converting Aether rotation (torsion) into observable electromagnetic phase. Physically, curl is the *torsional stiffness* of the Aether per unit magnetic charge.

Torsion susceptibility. Define the Aether torsion susceptibility as the response of phase torsion to unified force drive. The Josephson reluctance reads

$$\mathcal{R}_J \;\propto\; \frac{(\text{unified forcing})}{\mathrm{curl}},$$

which is why Josephson transport is an exquisitely sensitive "torsion transducer" of the unified Aether substrate.

Unified coupling for Josephson transport. Motivated by Eq. (7.6), define the junction unified coupling

$$\boxed{\mathrm{Gforce}_J \;\equiv\; \frac{G}{A_u\,k_C}} \tag{8.1}$$

so that

$$\mathcal{R}_J = \gamma_J\,\frac{\mathrm{Gforce}_J}{\mathrm{curl}}.$$

This isolates the physical punchline: Josephson transport measures the aether torsion susceptibility, i.e. unified forcing divided by torsional stiffness.[1]

9 Barrier geometry, curl coupling, and phase stiffness

The DC critical current and AC response both depend on

$$A_u \cdot \mathrm{curl} \;=\; \mathrm{rson}{\lambda_C}^2. \tag{9.1}$$

Raising curl (at fixed A_u) stiffens phase transport, increasing I_c and sharpening AC linewidths. Increased $\mathcal{R}_J$ from (7.7) reduces phase transport. Thus γ_J (geometry) and local curl (microstructure) jointly set junction performance at fixed $\Phi_\star$.

[1] If a global APM normalization uses a canonical Gforce differing by a dimensionless factor η_{UF}, then $\mathrm{Gforce}_J = \eta_{\mathrm{UF}}\mathrm{Gforce}$. Setting $\eta_{\mathrm{UF}} = 1$ is a convenient convention for Josephson analyses; restoring η_{UF} reconnects to cross-domain comparisons (Newton, Coulomb, Casimir).

Extracting curl **from data (sketch).** A two-geometry protocol separates geometry from substrate torsion: (i) fabricate junctions with two known $\gamma_J^{(1,2)}$, (ii) measure small-signal transfer slopes $S^{(1,2)} = |\delta I/\delta\mathcal{E}|$ at fixed ω and bias ϕ_0, (iii) use the linearized expression from Sec. 6 and (7.7) to solve

$$\frac{S^{(1)}}{S^{(2)}} = \frac{\gamma_J^{(1)}}{\gamma_J^{(2)}} \quad \Rightarrow \quad \text{eliminate geometry,} \qquad \text{then fit } \mathcal{R}_J \text{ to extract curl via } A_u\,\mathrm{curl} = {F_q}^2{\lambda_C}^2.$$

Because mflx and ccf are fixed ledger quantities, this procedure isolates curl as the only substrate parameter.

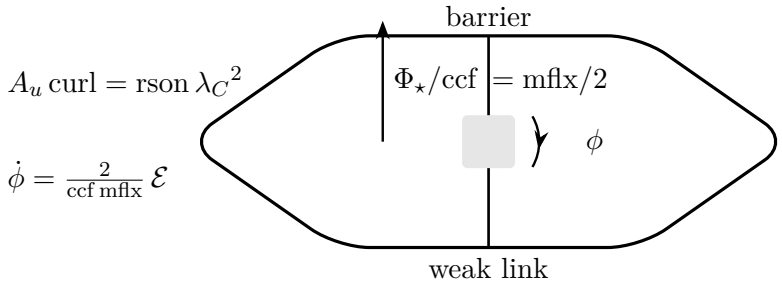

Figure 1: Schematic of a Josephson junction loop in the Quantum Measurement Units (QMU) framework within the Aether Physics Model (APM). The superconducting loop features a weak link across an insulating barrier (shaded region), where the phase difference ϕ (indicated by the curved arrow) enables coherent supercurrent tunneling. Key QMU ledger identities are highlighted: the quantized magnetic flux $\Phi_\star/\mathrm{ccf} = \mathrm{mflx}/2$, the phase evolution under electromotive drive $\dot{\phi} = \frac{2}{\mathrm{ccf\,mflx}}\mathcal{E}$, and the torsion stiffness relation $A_u\,\mathrm{curl} = \mathrm{rson}\,{\lambda_C}^2$. Barrier transport is modulated by aether torsion through curl, macroscopically expressed via the junction reluctance $\mathcal{R}_J$.

10 Conclusion and outlook

The QMU framework yields compact, fully internal expressions for Josephson phenomena:

$$\frac{\Phi_\star}{\mathrm{ccf}} = \frac{\mathrm{mflx}}{2}, \qquad K_J = \frac{2}{\mathrm{ccf\,mflx}}, \qquad \mathcal{R}_J = \gamma_J\,\frac{16\pi^2\,G}{A_u\,{F_q}^2{\lambda_C}^2} = \gamma_J\,\frac{G}{A_u\,k_C\,\mathrm{curl}}.$$

These depend only on APM/QMU quantities and ledger identities, with no mixed SI forms. Physically, the Josephson effect quantifies the Aether's torsion susceptibility—how unified forcing is converted into coherent phase transport—making Josephson systems a uniquely sensitive low-energy probe of APM unification. *Outlook:* the same torsion-ledger approach can be extended to chronovibrational spectra and magnetic-moment (g)-factor refinements within APM, potentially revealing further three-force symmetries in low-energy observables.

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