Creation of a Pure Glauber State in a Classical Macroscopic Object Based on Three Toroidal AC Drives with a $\pi/3$ Phase Difference

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A device driven by electromagnetic fields can exchange energy among modes without thereby establishing a change in the invariant mass of its entire apparatus[1,2]. Here we develop a Hamiltonian route to an exact transfer between spectral branches of one connected device using three mutually orthogonal toroidal alternating-current drives at relative phases 0, $\pi/3$ and $2\pi/3$. A phase-character identity isolates an exchange channel, while the actual transfer strength is determined independently by microscopic matrix elements. After diagonal detuning is compensated, the selected Hamiltonian reduces to a fixed-axis two-state generator. Its propagator yields unit target-sector population at an integrated pulse area of $\pi/2$, and an invariant field-off target remains populated in the ideal closed dynamics. The receiving branch is non-vacuum and has zero eigenvalue of a defined, device-specific mass operator; this is not a statement about the invariant mass of the larger apparatus and controller. Coherent bosonic source generation and conservation of energy and momentum are retained in the underlying ledger. The result identifies exact conditions for coherent spectral transfer and a falsifiable route to device calibration, rather than an experimentally demonstrated macroscopic loss of mass.

Coherent quantum control changes populations by shaping an interaction Hamiltonian. Familiar examples include resonant population exchange, bosonic coherent-state displacement and periodic Floquet engineering[1–5]. Most treatments begin with two prescribed states and a prescribed nonzero coupling. For a spatially extended device, however, the existence of an allowed coupling, its microscopic magnitude, the electromagnetic source of the coupling and the state left after the controls are removed are distinct questions. Conflating them can give an exact algebraic swap without showing how it arises from the parent Hamiltonian.

We address these questions together in an ideal connected-device theory. Three orthogonal toroidal control lines are supplied by alternating currents with rigid relative phases. The same three lines carry the required quadratures, without an additional coil, a direct-current bias or superconducting material as a prerequisite. The current pattern selects phase characters of the microscopic response. A spectral compression of the one-device Hamiltonian then supplies the exchange coefficient, whose nonzero value is tested against physical field–current overlaps rather than assumed through normalization. A compensated two-branch evolution finally reaches a projector that belongs to the original field-off spectrum.

The central conceptual distinction concerns the word *mass*. The endpoint described below is an eigenstate of a specified device-adapted absolute-mass operator $\widehat{M}^{\mathrm{abs}}_{\mathrm{dev}}$. The zero eigenspace of this operator need not coincide with the zero-invariant-mass sector of the fully closed apparatus, controller, support and electromagnetic field. The latter equivalence is neither postulated nor inferred. This distinction is necessary to state the claim at its mathematically supported strength.

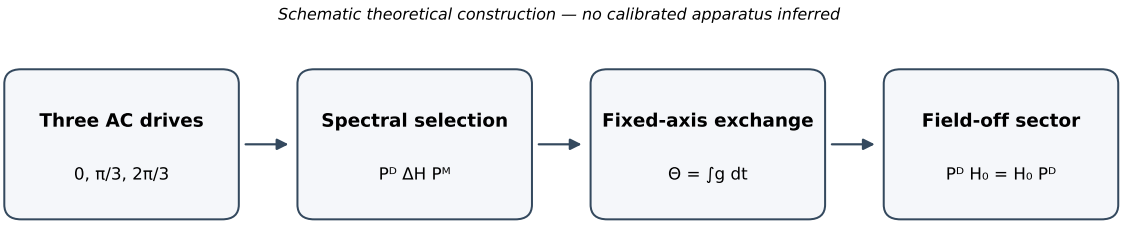


Figure 1: Parent-to-endpoint construction. The three alternating-current phases select an operator character of a single parent device Hamiltonian. Spectral compression identifies the addressed exchange, a compensated pulse rotates the two selected states, and the field-off Hamiltonian retains the endpoint if the target projector is invariant. All arrows are theoretical operations, not empirical data or a calibrated apparatus design.

Three-phase Hamiltonian response

Let $\mathcal{H}_{\mathrm{dev}}$ be the Hilbert space of one connected device and let $H_{\mathrm{dev}}(\mathbf{I})$ be its self-adjoint current-controlled Hamiltonian, with field-off reference $H_0 = H_{\mathrm{dev}}(\mathbf{0})$. Three physically distinct toroidal current lines, indexed by $a = 1, 2, 3$, carry

$$I_a(t) = A f(t) \cos(\omega t + \phi_a), \qquad (\phi_1, \phi_2, \phi_3) = (0, \pi/3, 2\pi/3). \tag{1}$$

The envelope $f(t)$ is shared and the amplitude A is a control amplitude, not a current calibrated in amperes until the device-specific conversion has been provided. The linear operators $O_a = \partial_{I_a} H_{\mathrm{dev}}|_{\mathbf{I}=0}$ coexist with quadratic, diamagnetic, spin, elastic and interface terms. Accordingly, no calculation below deletes

the $\mathbf{A}^2$ term of minimal coupling. Phase compensation includes the diagonal part inherited from those contributions.

The source combination of orientation sign $s = \pm 1$ is

$$L_s = \frac{1}{3} \sum_{a=1}^{3} e^{is\phi_a} O_a. \tag{2}$$

For $s = +1$, the exact identity $1 - e^{i\pi/3} + e^{2i\pi/3} = 0$ removes the source direction proportional to $(1, -1, 1)$ in this character projection. It does *not* imply that every unwanted Hilbert-space matrix element vanishes. Clock, translation, spectral support and finite-control remainders must be checked separately before a projected two-branch dynamics can be declared invariant.

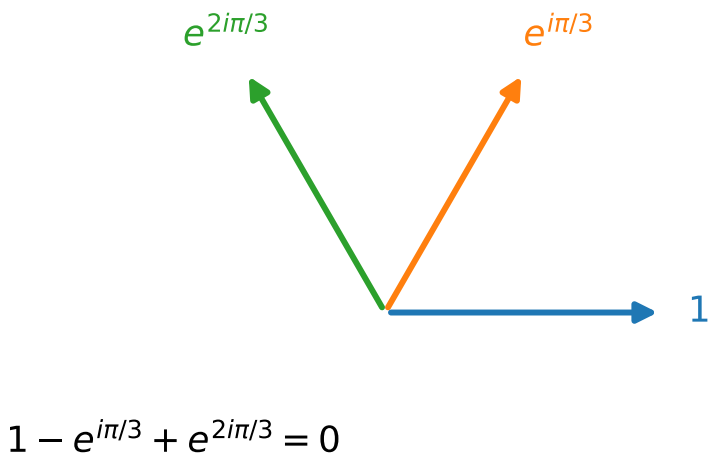


Figure 2: Three drive phases and a null character. The phasors correspond to the control phases in equation (1). Their signed combination obeys the exact zero identity shown. This algebra removes one source character; it is not, by itself, a no-leakage theorem for the full device.

Let P_M and P_D be mutually orthogonal joint spectral projectors of the same field-off device description, denoting the initial and retained target branches. The physically relevant block is

$$X_* = P_D \left[H_{\text{dev}}(\mathbf{I}) - H_0 \right] P_M. \tag{3}$$

In the resolved single-quantum coordinate representation, field and transition-current overlaps give coef-

ficients $g_{\mu,s}$. The nonzero-coupling test is the norm identity

$$\|H_{\mathrm{conv}}(|M\rangle \otimes |0_D\rangle)\|^2 = \hbar^2 \sum_{\mu\in\mathcal{R}_\Delta} |g_{\mu,s}|^2, \qquad P_D H_{\mathrm{conv}} P_M \neq 0 \iff \sum_{\mu\in\mathcal{R}_\Delta} |g_{\mu,s}|^2 > 0. \tag{4}$$

The resonant set is $\mathcal{R}_\Delta = \{\mu : \hbar\omega_\mu = \Delta\}$. Equation (4) separates a symmetry-allowed matrix element from the independent fact that a particular device has a nonzero microscopic overlap. The unabridged technical source, retained in Supplementary Information, supplies the corresponding current, charge, spin and interface terms explicitly. These terms must be evaluated with measured or otherwise established operators before a material-specific device can be claimed to realise the nonzero branch.

Exact transfer and field-off retention

In the invariant addressed pair, the projected Hamiltonian has a scalar term, a relative diagonal detuning and the off-diagonal exchange. Under the explicit phase-compensation and leakage-cancellation conditions, the nontrivial part becomes

$$\widetilde{H}_2(t) = \hbar g(t) S_\theta, \qquad S_\theta = \begin{pmatrix} 0 & e^{-i\theta} \\ e^{i\theta} & 0 \end{pmatrix}, \qquad S_\theta^2 = \mathbf{1}. \tag{5}$$

The phase θ is constant on the compensated exchange axis; therefore $[\widetilde{H}_2(t), \widetilde{H}_2(t')] = 0$ and the propagator is exactly

$$U_2(t) = \cos\Theta(t)\,\mathbf{1} - i\sin\Theta(t) S_\theta, \qquad \Theta(t) = \int_{t_i}^{t} g(t')\,dt'. \tag{6}$$

For an initial coordinate state $|\mathsf{M}\rangle$, the target population is $F_D(t) = \sin^2\Theta(t)$. Its first complete transfer occurs at $\Theta(t_f) = \pi/2$, when

$$U_2(t_f)|\mathsf{M}\rangle = -ie^{i\theta}|\mathsf{D}\rangle, \qquad \mathrm{Tr}(P_D\rho_f) = 1. \tag{7}$$

This is an exact ideal-theory statement about the selected block, not an assertion that any externally chosen three-coil configuration automatically has a $\pi/2$ calibrated pulse, nor that its full-system leakage is zero. A finite envelope that vanishes at t_f makes transfer and switch-off coincide without declaring the control duration itself to be zero.

The endpoint requires more than high population. The target projector must be a *retained* zero eigenprojector of $\widehat{M}^{\mathrm{abs}}_{\mathrm{dev}}$, with no support in the vacuum projector $Q_\varnothing$, and it must be invariant under H_0. In the

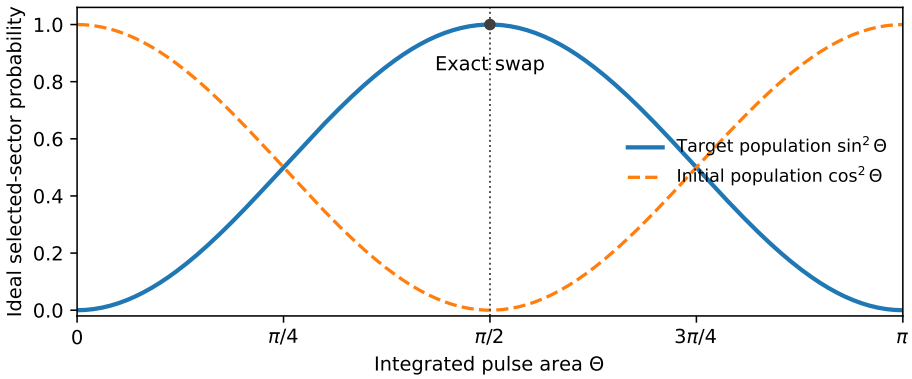


Figure 3: Exact pulse-area law in the invariant two-state sector. Target and initial populations follow $\sin^2\Theta$ and $\cos^2\Theta$, respectively, under equation (5). The first unit-fidelity point is $\Theta = \pi/2$. Curves are analytical identities, not simulated or measured device traces.

notation of the full source,

$$\widehat{M}^{\mathrm{abs}}_{\mathrm{dev}} P_D = 0, \quad Q_{\varnothing} P_D = 0, \quad [H_0, P_D] = 0. \tag{8}$$

The state is therefore non-vacuum and has zero *device-defined* absolute mass; an occupied intrinsic receiving sector carries the complementary energy. Under ideal closed dynamics after switch-off, the field-off propagator preserves the range of P_D because $[H_0, P_D] = 0$. This stationary spectral support does not imply that real open hardware has infinite lifetime. A decay rate requires the actual environment coupling and loss spectrum.

Energy and momentum conservation

A mass-sector exchange must not be presented as energy elimination. The microscopic exchange is formulated with the source, controller, fields, recoil, interface and supports accounted for in the full energy–momentum ledger. On a resonant conversion channel r, the exchange algebra yields the current–force relation

$$\mathbf{F}_r = \frac{\boldsymbol{\kappa}_r}{\omega_r} J_r, \qquad \Delta\boldsymbol{\Pi}_P = \sum_r \frac{\boldsymbol{\kappa}_r}{\omega_r} \int_{t_i}^{t_f} \langle J_r(t) \rangle \, dt. \tag{9}$$

At exact dark endpoints the selected interaction contribution vanishes and the balanced energy ledger reduces to $E_{D,f} - E_{D,i} = E_{P,i} - E_{P,f}$. The energy need not vanish when the device mass operator has a zero eigenvalue. In particular, these equations do not assert a source of free energy, superluminal signalling or the disappearance of the invariant rest mass of the globally closed device and controller.

A linear bosonic source can generate a pure Glauber state through a Weyl displacement $|\beta\rangle = D(\beta)|0\rangle$, preserving standard coherent-state algebra[2,3,6]. Such an input or source record must not be conflated

with the full connected-device state: a moving input embedding, global Schrödinger evolution and an endpoint record are separate constructions in the technical source. Our present central claim concerns the selected spectral transfer of the connected device. Purity, retained occupation and output emission are distinct observables; any extension from the source coherent state to a universal whole-device Glauber state requires its complete intertwining or dynamical reconstruction, not merely an identical notation for state vectors.

What can be tested

The parent theory specifies algebraic signatures that could be measured once the actual Hamiltonian and currents are calibrated. The source-character sign should change under an appropriate physical mirror or phase reversal; off-character response should be suppressed relative to the selected channel; the target population should follow the pulse-area dependence after measured detuning compensation; and the field-off spectral occupation should be distinguished from transient driven micromotion. These are independent tests, so successful phase arithmetic alone cannot count as verification of the mass endpoint.

Table 1: Evidence level and permissible interpretation of the available material. The supplied computational archives classify exact identities, finite-dimensional or address-code checks, required calibrated inputs and measurements separately.

Category	Evidentiary meaning
Analytic identity	Algebraic source null, commuting two-state propagator and conservation commutators, provided their stated hypotheses hold.
Finite model / address code	Executable model checks and round-trip address algebra; not physical current, force or device transfer measurements.
Calibrated device prediction	Requires independently specified H_0, O_a, physical field bases and current spectra with units and provenance.
Experimental demonstration	Requires measured state preparation, current and energy accounting, state discrimination and field-off lifetime. No such hardware dataset is supplied.

The available reproducibility bundle contains forward mathematical tests and strict input guards. In particular, its missing-input guards deliberately return without generating numerical currents when calibrated device spectra are absent. These guard results are a reproducibility feature, not evidence that the proposed macroscopic apparatus has been constructed. Likewise, exact state retention refers to a closed-system theorem rather than a demonstrated open-system lifetime. The consequential experimental challenge is to produce a physical device with independently nonzero overlap, resolvable retained branch and measurable leakage bounds, and to compare its observed $F_D(t)$ with equation (6).

Discussion

The proposed construction joins the symmetry of a three-phase electromagnetic drive to a spectral-projector condition and an exact two-level exchange. Its central mathematical result is an explicit conditional transfer theorem: in the presence of the established microscopic selected block, exact suppression of competing support, compensated detuning, a $\pi/2$ pulse and an invariant non-vacuum zero-device-mass sector, the target projector is reached with unit population and is held after the field is switched off. The conservation ledger prevents this from becoming a claim that excitation energy disappears.

This criterion gives a disciplined experimental agenda rather than a claim of completed macroscopic mass erasure. Its conceptual relevance is the precise distinction between a phase-selected coupling, a spectrally occupied branch and the mass observable to which a zero eigenvalue applies. A general comparison of the device-defined operator with the invariant mass of the full closed apparatus, and calibration of a working hardware instance, remain required before a broader physical masslessness assertion could be made.

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Methods

Hamiltonian and spectral domains

The derivation starts from one self-adjoint $H_{\mathrm{dev}}(\mathbf{I})$, including matter, electromagnetic field, diamagnetic and mechanical terms, rather than postulating a pairwise swap as fundamental. The coordinates $\mathbf{I}$ are control variables; the associated physical vector potential and Maxwell fields are supplied by the same three controlled lines. The complete derivation, reproduced in the Supplementary Information, constructs joint spectral projectors from the field-off energy, momentum and defined absolute-mass observables. Spectral intersections and their Riesz representatives are described in the complete technical archive. All differentiations and spectral restrictions in the reduced treatment must occur on the retained common operator domain. Exactness of the two-state dynamics requires an invariant block; projection by itself does not make an approximate Floquet truncation exact.

Microscopic selection and coupling

The first control derivatives O_a form the collective source operator in equation (2). The phase plane annihilates the complement vector through its exact trigonometric identity. For a resolved transition, the resonant coefficient $g_{\mu,s}$ is obtained by an overlap integral between the transition current and the corresponding field mode, with the independent charge–scalar-potential, spin and elastic/interface contributions retained. Orthogonality of one-quantum final states proves the norm equality in equation (4), which gives the stated necessary and sufficient condition for a nonzero block within that representation. A physical realization cannot infer positivity from $\|X|M\rangle\|$ if X has not already been shown nonzero.

Compensation and exact propagator

The full matched-exchange derivation reproduced in the Supplementary Information resolves the unselected spectrum and records diagonal terms from the quadratic response. The selected Hamiltonian can be written $H_2 = w_0\mathbf{1} + (\hbar\delta/2)\sigma_z + \hbar(\Omega\sigma_- + \Omega^*\sigma_+)$. Removing w_0 is a common phase and does not discard stored energy. Compensating the *derived* differential detuning, including appropriate higher-order terms when retained, gives a fixed generator S_θ and the commuting propagator (6). If the omitted-space coupling has nonzero norm, the two-state formula becomes a conditional or approximate description rather than a unit-fidelity theorem for the entire Hilbert space. Exact zero leakage and exact phase matching are therefore hypotheses to check in a concrete device.

Field-off endpoint and control time

An invariant field-off target requires P_D to be a joint spectral projector obeying equation (8). The connected-device energy exchange obeys the explicit ledger stated in the main text. With $[H_P, L_r] = -\hbar\omega_r L_r$ and $[\mathbf{\Pi}_P, L_r] = \hbar\boldsymbol{\kappa}_r L_r$, the commutator definitions $J_r = (i/\hbar)[H_P, V_r]$ and $\mathbf{F}_r = (i/\hbar)[V_r, \mathbf{\Pi}_P]$ yield equation (9) by direct substitution. An ideal field-off hold means the selected interaction is absent after t_f; it does not mean a zero-duration pulse. If an external bath couples the retained projector to other branches, the bound on leakage or lifetime must be computed for that bath, not inserted by assumption.

Computational scope

The preserved source package describes reproducibility modules covering partial-mass, receiver engineering, steering time evolution, position character encoding, event encoding, finite quantum protocols, photonic circuit finite models and a calibrated-input boundary test. The accompanying Supplementary Information includes the complete original 453-page theory and its source-level descriptions of these modules; executable files require independent deposit. A passing finite canonical calculation establishes an algebraic or model property, not a measured device response. We did not fabricate a calibrated Maxwell field basis, current spectrum, apparatus Hamiltonian or experimental error bar. No statistics or replicates are reported as experiments.

Use of language-model assistance

An OpenAI language model was used to prepare and reorganize this condensed submission manuscript from the author-supplied technical source. This use does not constitute scientific validation. The author retains responsibility for all derivations, source accuracy, originality and submission disclosures. The author must confirm this statement and the final submitted version.

Data availability

No measured device dataset is reported. The theoretical derivations and computational verification artifacts accompanying the manuscript are included in the preserved source archive. No permanent public identifier for this specific research dataset has been verified. A public archival link and access permissions should be checked by the corresponding author before submission.

Code availability

Runnable source and recorded validation outputs are included in the accompanying original reproducibility modules. These do not replace the calibrated inputs required for a physical device prediction. A verified editor-accessible source-code deposit must be established before formal submission; the Supplementary Information preserves the mathematical derivations but is not itself an executable repository.

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J.J.H. is identified as the author of the supplied technical manuscript. The author should confirm the formal contribution statement.

Competing interests

Competing interests have not been independently verified; the author must enter the required declaration at submission.

Additional information

Correspondence and requests for materials should be addressed to J.J.H. Supplementary Information is available for this manuscript. It contains Supplementary Notes and the entire 453-page unabridged theory. An editor may request the long technical source to be reformatted or split into a more selective peer-review supplement. No content has been discarded from the archival version.