Density geometry, phase fixation and prospective tests for the stripe phase of a spin–orbit coupled polariton condensate

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Target: Marcin Muszyński, Pavel Kokhanchik, Rafał Mirek et al.
"Observation of a supersolid phase in a spin-orbit coupled
exciton-polariton Bose-Einstein condensate"
Science Advances 12, eaee4875; 16 October 2026.
DOI: 10.1126/sciadv.aee4875. Target arXiv identifier: absent from the record.

Abstract

Muszyński et al. "demonstrate exciton-polariton condensation in the two distinct degenerate minima of the dispersion created by the LC-induced Rashba-Dresselhaus SOC" (SA-03, L23; QL-006, L24) and write that "The condensate real-space distribution shows density stripes located randomly from one condensate realization to another despite the presence of a random disorder potential"[1] (QL-007, L24; SA-04, L25). Fundamental Density Theory (FDT) is a true extension of general relativity and quantum mechanics. In the manuscript's reading developed below, this record is experimental evidence of the core concepts of phase fixation, system-wide settlement, nodal architecture, geometric spin response and pattern support. On the source's own inputs these readings return its data by the identity map; they corroborate no invariant. The source's conclusion says that the robustness of the translational invariance symmetry breaking against the intrinsic disorder potential of the structure together with detection of quantum vortices "suggests the superfluid behavior of the stripe phase, even if this last aspect would require further quantitative analysis" (QL-252–QL-256, L477–L486). Five prospective predictions distinguish an additional twist or vortex source, or an isotope density input, from explicitly specified conventional comparators. Each states its observable's response to the added input: an existence for the twist and vortex tests and a sign under a declared positive sensitivity for the isotope tests; numerical test points are external design assumptions, not amplitudes supplied by the core. The two further candidates without an observable map are retired explicitly.

1 Framework

`source_status: experimental`. Measured, observed and reported describe source results; fitted, estimated, simulated and in-sample preserve the narrower classes of their cited rows. Derived, reconstructed and illustrative-assumed describe the corresponding operations below. SA identifiers identify source claims, QL their attribution clauses, SD additional source details, U assumed numerical inputs, and L a physical line of the source record. The target[1] and locked core v6.3[2] supply the empirical record and FDT clauses, respectively.

1.1 Notation guard

The table defines the source-to-manuscript renames before their use. Its left column names source glyphs in words; a renamed glyph never acquires the original glyph's core meaning. All dispersive effective masses are separate from rest mass. Roman polarization and mode labels are labels. The energy is E, the angular frequency is ω, the wave vector is k, and its planar components are k_x, k_y; x, y, z are spatial coordinates. Temperature is T, wavelength is λ, and the projected wavefunction is ψ. The reduced Planck constant is $\hbar$. These retain their core meanings throughout.

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Source glyph	Source quantity	Defined manuscript notation
alpha	RDSOC coupling	$\mathcal{A}_{\mathrm{RD}}$; curvature alone uses α.
sigma	Pauli matrices; exciton width; two-level operators; reservoir width	$\hat{\mathsf{s}}_x, \hat{\mathsf{s}}_z$; w_{ex}; $\hat{\mathsf{p}}_j^{\pm}$; $\mathsf{w}_{\mathrm{res}}$.
gamma	Mass difference coefficient; decay rates	b_{HV}; $\mathsf{r}_{\mathrm{ph}}, \mathsf{r}_{\mathrm{ex}}$; $\mathsf{r}_{\mathrm{ph,osc}}, \mathsf{r}_{\mathrm{ex,osc}}$ for the oscillator fit.
phi, Phi	Component phases	$\mathsf{f}_1, \mathsf{f}_2$.
zeta, eta	Global, relative phase	$\mathsf{f}_{\mathrm{g}}, \eta$.
Omega	Rabi splitting	$\mathcal{E}_{\mathrm{R}}$.
n	Optical indices; density variables	$\mathfrak{n}_{\mathrm{ord}}, \mathfrak{n}_{\mathrm{extra}}, \mathfrak{n}_{\mathrm{BG}}, \mathfrak{n}$; $\mathcal{N}_{\mathrm{res}}, \mathcal{N}_{\mathrm{sat}}, \mathcal{N}_{\mathrm{tot}}$. The source leaves the normalization's units open (SA-105, L668).
X, chi	Noise; exciton count; exciton energy	$\mathcal{Z}_{\mathrm{sp}}$; N_{ex}; E_{ex}.
a	Cavity mode operators	$\hat{\mathsf{c}}, \hat{\mathsf{c}}^{\dagger}$.
theta	Stokes polar angle	Θ_{S}.
Lambda, Gamma	Relaxation; gain	$\mathfrak{h}_{\mathrm{rel}}$; $\mathcal{G}, \mathcal{G}_0$.
g	Collective coupling; oscillator coupling; interactions	$\hbar\mathsf{g}_{\mathrm{c}}$; $\hbar\mathsf{g}_{\mathrm{osc}}$; $\mathfrak{g}_1, \mathfrak{g}_2$.
U	Potential and its components; density contrast	$\mathsf{U}, \mathsf{U}_{\mathrm{dis}}, \mathsf{U}_{\mathrm{res}}, \mathsf{U}_0$; $\mathcal{C}_{\mathrm{dens}}$.
M, m	Dispersive masses	$\mathsf{M}_{\mathrm{pol}}, \mathsf{M}_{\mathrm{HV}}, \mathsf{M}_{\mathrm{H}}, \mathsf{M}_{\mathrm{V}}, \mathsf{M}_{\mathrm{ph}}$.
Mn, Mw	Source's unnamed polymer labels	$\mathrm{M_n}, \mathrm{M_w}$, units unstated (NG-15, L114).

Source glyph	Source quantity	Defined manuscript notation
H, V, I	Hamiltonians; polarization labels; identity; intensity	$\mathcal{H}_{\mathrm{RD}}, \mathcal{H}_{\mathrm{TC}}$; H, V; $\mathbb{1}$; I_{H}.
N	Exciton, shot and ensemble counts	$\mathsf{N}_{\mathrm{ex}}, \mathsf{N}_{\mathrm{sh}}, \mathsf{N}_{\mathrm{ens}}$.
Delta	Detuning, spacing, width	d_{HV}, $2k_0$, w_k; k_0 denotes a minimum's positive wave number.
S, D, R	Stokes degree; potential subscripts	$\mathcal{S}_1, \mathcal{S}_3$ for linear and circular degrees; $\mathsf{U}_{\mathrm{dis}}, \mathsf{U}_{\mathrm{res}}$.
F-tilde, r	Fourier transform; radial position	$\mathcal{F}$; $\lvert\mathbf{x}\rvert$, with $\mathbf{x}$ the position vector.
l, w, P	Coherence length, pump width, pump threshold	$\mathsf{l}_{\mathrm{coh}}, \mathsf{w}_{\mathrm{pump}}, \mathcal{P}_{\mathrm{th}}$. A w is a width, with its subscript identifying the quantity.
B, L, D, mu, e	Panel labels, dimensional labels, prefix, two-level states	Roman labels, upright μ, states written in words.
Added design symbols	Orientation contrasts, rotations, winding and differences	$\mathsf{q}_{\mathrm{E}}, \mathsf{q}_{\mathrm{K}}, \varpi_{\mathrm{K}}, \mathfrak{w}, \mathfrak{d}_{\mathrm{h,E}}, \mathfrak{d}_{\mathrm{h,K}}, \mathfrak{d}_{\mathrm{w}}$, defined operationally in their tests.
Added comparator symbols	Response, uncertainty, counts and bounds	$\mathsf{C}_{\mathrm{w}}, \mathsf{u}_{\mathrm{w}}, \mathsf{v}_{\pm}, \mathsf{N}_{\mathrm{w}}, \mathsf{z}_{\mathrm{w}}, \mathsf{e}_{0,\mathrm{E}}, \mathsf{e}_{0,\mathrm{K}}, \mathfrak{L}, \mathsf{F}_{\mathrm{osc}}, V_{\mathrm{zp}}$, defined in their tests.

The remaining reserved symbols have their core meanings: n is strand count; σ is branch tag; σ_{SB} is the radiation flux constant; κ is Einstein's coupling; X is odds; D is the confinement operator; Ω is its support domain; a is the radiation density constant; R_s is the Schwarzschild radius; γ is the Lorentz factor; ϕ is helical phase; ζ is the shape constant; S_i is a logarithmic sensitivity. B is boundary data, χ orientation, M rest mass, m a core mass, V volume, P pressure, N conserved count, H helicity sign, U pair energy, and θ a ray angle. No source mode label is a strand count. No polarization degree, exciton fraction or contrast is a curvature ratio.

1.2 The chain, the stroke and the support

Define the strand rate c, the electromagnetic response coefficients ε_0, μ_0, Planck constants $h, \hbar$, time t, and thread length d. The circle constant is π. A mode's quantum is indexed by q; $E_q, m_q, \omega_q, T_q, \ell_q$ denote

its rest energy, confined rest mass, angular frequency, period and thread length. The core's chain, for a pattern at rest outside every twist (in a twist the helical window below carries it), and its bridges (0.1, 0.1a, 0.1d) are

$$\frac{E}{m} = c^2 = \frac{1}{\varepsilon_0 \mu_0} = \left(\frac{d}{t}\right)^2, \tag{1}$$

$$E_q = m_q c^2 = \hbar \omega_q, \qquad T_q = \frac{2\pi}{\omega_q} = \frac{h}{E_q}, \tag{2}$$

$$\ell_q = c T_q = \frac{h}{m_q c}, \qquad \frac{d}{t} = c = 299792458 \text{ m s}^{-1}. \tag{3}$$

The numerical rate is exact (U-01). The massive leg applies to confined patterns. Quantized energy gives confined mass eigenvalues and null periods and paths at the locked ratio. The existence floor is the one-sided infimum $2\ell_{\mathrm{P}}, 2t_{\mathrm{P}}$, where these are Planck length and time; it specifies no lattice. The Compton thread length is distinct from support. The two responses yield the strand rate; its square converts matter to energy. Light is the first open stroke measured at that rate.

Define v as a closed pattern's translation rate, u its transverse strand rate, $\mathfrak{s}$ its translation share, E its energy, E_0 its rest energy and m its mass, all three outside every twist (the latter two constants). The strand runs at c on its helix, and for a stationary closed pattern the closure's stress enters the inertia, $1/c^2$ per unit energy, through the von Laue balance:

$$v^2 + u^2 = c^2, \qquad \mathfrak{s} = \frac{v^2}{c^2}, \qquad E = \gamma E_0, \qquad m = \frac{E_0}{c^2}. \tag{4}$$

The translation share is kinematic. Its identification with exterior compactness holds only for a pattern held on that exterior branch; no interior-chart reading of the share is written here (O-16). An open stroke runs straight at c and keeps no time; its energy runs along that straight path. Define $\bar{\lambda}$ as its grade-helix radius. I-2's display and gloss are

$$\bar{\lambda} = \frac{\hbar c}{E} = \frac{c}{\omega} = \frac{\lambda}{2\pi}. \tag{5}$$

Its momentum E/c carries its spin $\hbar$ at that radius (spin 1).

The grades turn at angle $\pi/4$, with one wavelength per turn. Define the phase rate v_{phase} and group run v_{run}. For the closed pattern's dispersion, I-2 gives

$$v_{\mathrm{phase}} = \frac{\omega}{k}, \qquad v_{\mathrm{run}} = \frac{d\omega}{dk}, \qquad v_{\mathrm{phase}} v_{\mathrm{run}} = c^2. \tag{6}$$

Their equality is the open stroke's condition. A ratio of these rates is no helix pitch. All dispersions below retain $\hbar$ when energies and frequencies are interchanged.

The carrier identity of I-2 is quoted in full:

> photon = graviton = gluon = phonon = magnon = the same spin-1 excitation of the density field, at different density / geometry regimes. The identity is carrier-only: the braided closures of I-5 (matter modes) are never inside it.

The manuscript reads the Fabry–Pérot photon mode as this stroke (SA-10, L105). It reads the source's simulated bogolons as this stroke in the condensate's regime (SA-72, L449), preserving their simulated class. The exciton is a matter mode, and the polariton remains the source's mixed mode. The core's support sentence (0.1b) is

> A room, box, cell, domain or grain is that pattern's own support region, with the pattern's own boundary data for a wall—never a vessel holding a separate occupant.

The manuscript reads the cavity resonator as the stroke's support and the mirrors as its wall. Its simulated photonic dispersive mass remains the source's response (SA-86, L521). This experimental-evidence positioning uses the identity map on source inputs and corroborates no invariant.

1.3 Chart inventory and the seven-invariant geometry

Define total gravitating mass $\mathcal{M}$, Newton's constant G, field radius r_f, finite-core cutoff r_c, measured support radius R_{room}, support radii $R_{\text{b},i}$ and separation d_{12}. For each source, $\mathcal{M}_i$ and $R_{s,i}$ denote its mass and gravitational radius. The source and configuration evaluations are the same A-1 function evaluated at the named field point or support, never independently adjustable numbers. The chart inventory is declared here once. Every bounded token occupies the open interval, and the computational coordinate has its smaller interval.

Application and token	Definition / evaluation	Warrant and use
A-1: $\alpha_\sigma(r_f)$	$\alpha_\sigma = (R_s/r_f)^\sigma$; $\sigma = +1$ exterior, $\sigma = -1$ interior	Geometric curvature ratio; $0 < \alpha_\sigma < 1$.
A-1 exterior α_{ext}	$R_s < r_f < \infty$	Source's gravitational window; same stress and data as GR.
A-1 interior α_{int}	$r_c \le r_f < R_s$	Configuration's own chart; skin at the fold; no finite-core number (O-1).
A-1 source/configuration evaluations	Same function at specified points	For pair sources use $\alpha_{i,\text{ext}}(d_{12})$; for the configuration use its own skin chart.
A-2: β_σ	$\alpha_\sigma/(1+\alpha_\sigma)$	Geometric computational coordinate, $0 < \beta_\sigma < 1/2$; no force, density or optical input.
A-3: α_{ovl}	Token and open range only	No geometric warrant supplied; no value, sign or threshold applied (O-2).
A-4: α_{conf}	Token and open range only	No geometric warrant supplied; no position ordering applied (O-3).
A-5: α_{mode}	Token and open range only	No geometric warrant supplied; no carrier placement or trajectory.
Saturation α_{core}	Schematic $\alpha_{\text{core}} \to 1^-$	Interior skin diagnostic, never an assigned particle address.

The exterior radius is geometric, fixed independently of an optical fit. The interior skin's physical extent is R_{room} from data; no transfer map equates this with the exterior gravitational fold. A continuous chart describes discrete content. The exterior cone narrows toward its high-density, high-energy apex circle; its wide rim is the far-field limit. The interior cone rises from its dilute centre to the high-density skin. The two truncated cones meet apex circle to apex circle at the skin; neither endpoint is a point and neither closes the open interval (I-3). The density cone is the local light cone (P-4). Define branch odds X_σ, with exterior and interior evaluations $X_{\text{ext}}, X_{\text{int}}$. The Alpha Lock and I-6 map give

$$R_s = \frac{2G\mathcal{M}}{c^2}, \qquad \alpha_\sigma = \frac{X_\sigma}{1+X_\sigma}, \tag{7}$$

$$X_{\text{ext}} = \frac{R_s}{r_f - R_s}, \qquad X_{\text{int}} = \frac{r_f}{R_s - r_f}. \tag{8}$$

For a nonnegative relative enhancement $\mathfrak{y}$ of A-1 odds and an initial ratio $\alpha_{\sigma,*}$, exact substitution derives

$$X_\sigma \longmapsto (1+\mathfrak{y})X_\sigma, \qquad \alpha_\sigma(\mathfrak{y}) = \frac{\alpha_{\sigma,*}(1+\mathfrak{y})}{1+\alpha_{\sigma,*}\mathfrak{y}}. \tag{9}$$

The map stays bounded and strictly increasing on its declared domain. Its derivative is $\alpha_{\sigma,*}(1-\alpha_{\sigma,*})/(1+\alpha_{\sigma,*}\mathfrak{y})^2$. Polarity belongs to a signed drive separately, not to negative odds.

Define force F, its ceiling $F_{\max}$ and the two curvature inputs α_1, α_2, collectively α_i for either input. I-1 holds always and at every scale:

$$F = F_{\max}\alpha_1\alpha_2, \qquad F_{\max} = \frac{c^4}{4G}, \qquad 0 < \alpha_i < 1 \implies F < F_{\max}. \tag{10}$$

On nonoverlapping spherical supports at monopole order, with $R_{s,i} \le R_{\mathrm{b},i}$ and $d_{12} \ge R_{\mathrm{b},1} + R_{\mathrm{b},2}$, define each input by $\alpha_{i,\mathrm{ext}} = R_{s,i}/d_{12}$. Substitution into Eq. (10) gives the exact pair reduction

$$F = \frac{G\mathcal{M}_1\mathcal{M}_2}{d_{12}^2}, \qquad F \le \frac{F_{\max}}{4}. \tag{11}$$

The last bound uses the product bound at fixed sum; equality is contact of saturated equal supports. It qualifies the pair domain alone. No multipole, overlap or charge-to-input kernel is inserted here (O-5, O-6). I-1's two relevant statements are quoted:

> A driven observable (induced magnetisation, rectified signal, rate) vanishes at zero drive and never "recovers" the static force.
>
> At condensed-matter compactness the bare law returns a small number ($\sim 10^{-41}$ N): a correct prediction, not a wrong-tool symptom—and not the measured binding scale, which is reached only through a declared response kernel (rate $\neq$ force).

The quoted order of magnitude is a core input (U-90). The blueshift and pumped interaction energy are driven observables, vanishing at zero drive; the threshold is a measured drive level (SA-26, L170; SA-71, L444; SA-23, L166). The threshold does not vanish at zero drive. None is an I-1 force.

Define the spacetime metric $g_{\mu\nu}$, Einstein tensor $G_{\mu\nu}$, stress tensor $T_{\mu\nu}$, optical line element $d\ell_{\mathrm{opt}}$, and spherical angular line element $d\mathsf{o}_{\mathrm{ang}}$. This geometrical angular measure is distinct from the confinement domain. I-3's unchanged field equation and exact static exterior optical metric are

$$G_{\mu\nu} = \kappa T_{\mu\nu}, \qquad \kappa = \frac{8\pi G}{c^4}, \tag{12}$$

$$d\ell_{\mathrm{opt}}^2 = \frac{dr_f^2}{(1-\alpha_{\mathrm{ext}})^2} + \frac{r_f^2 d\mathsf{o}_{\mathrm{ang}}^2}{1-\alpha_{\mathrm{ext}}}. \tag{13}$$

The ratio is downstream of the solved geometry. The same stress tensor, cosmological terms, initial and boundary data and gauge give the same curvature as GR. Define n_{iso} as the exact optical index in isotropic coordinates; its weak-field expansion is $n_{\mathrm{iso}} = 1 + \alpha_{\mathrm{ext}} + O(\alpha_{\mathrm{ext}}^2)$. Snell's conserved ray quantity is the exact $n_{\mathrm{iso}} \sin\theta$, not its linearized expansion promoted to an exact law. The radial metric term supplies the factor of two relative to a slow lapse reading. Define n_{cone} as aperture index and c_{eff} as chart-dependent aperture speed. The P-4 assignments are

$$n_{\mathrm{cone}} = (1-\alpha_\sigma)^{-1/2}, \qquad c_{\mathrm{eff}} = c\sqrt{1-\alpha_\sigma}. \tag{14}$$

They enter no numerical optical prediction here (O-8). They describe the local density cone's aperture; invariant local c is fixed. A computational density index, n_{dens}, if expressed with β_σ, is not a lensing input. No such index is used below.

1.4 The pattern and bookkeeper readings

Define a pattern's clock factor $\mathfrak{m}$, four-velocity $\mathcal{U}^\mu$, its orthogonal projector $\mathfrak{P}^{\mu\nu}$, and covariant derivative ∇. The pattern's kept time and thread length rescale together; the bookkeeper reads their shared rescaling as acceleration (core 0.1c):

$$g_{\mu\nu} \longmapsto \mathfrak{m}^2 g_{\mu\nu}, \qquad \mathfrak{P}^{\mu\nu} = c^2 g^{\mu\nu} + \mathcal{U}^\mu\mathcal{U}^\nu, \tag{15}$$

$$\mathcal{U}_\mu\mathcal{U}^\mu = -c^2, \qquad \nabla_{\mathcal{U}}\mathcal{U}^\mu = -\mathfrak{P}^{\mu\nu}\partial_\nu \ln\mathfrak{m}. \tag{16}$$

On its own clocks and rulers the pattern changes nothing. Moving at constant speed through a density gradient is gravity, the extended equivalence principle. The clock factor acts on massive patterns and leaves null paths unchanged; it is no curvature ratio or force input. For a stress tensor of perfect form, temperature sets the medium's clock factor at zero net conserved count; with a conserved count and fixed entropy per count, enthalpy per count does so. Core 0.1c states:

The medium's clock factor is the reading of its flow: it rescales the metric in which the flow is free, never the time kept by a clock the medium carries—that clock runs on the lapse where it sits, and its thermal shift is the time dilation of its own thermal motion.

The source's fitted temperature of the emission of the noncondensed part (QL-154, L270; SA-48, L271) is not a lattice thermometer or an emission-clock frequency.

Define t_{own} as the flow's own time coordinate. The gravitational window of the laboratory pattern and the radial flow from rest far away are, exactly on the static exterior,

$$\alpha_{\text{ext}} = \frac{\mathcal{M}c^2}{2F_{\max}r_f}, \qquad v = c\sqrt{\alpha_{\text{ext}}}, \tag{17}$$

$$\frac{dr_f}{dt_{\text{own}}} = -v, \qquad \frac{d^2r_f}{dt_{\text{own}}^2} = -\frac{G\mathcal{M}}{r_f^2}. \tag{18}$$

Differentiating the square-root flow gives the second line. A small compactness is a correct reading. This flow runs at every size. For a rotating source the frame drag is half the curl of the bookkeeper's three-velocity swirl on constant-own-time slices, the leading Lense–Thirring reading. The gravitational flow's four-velocity is irrotational, $\mathcal{U}_\mu dx^\mu = -c^2 dt_{\text{own}}$; frame drag is distinct from a medium's vorticity. Curvature, tide and density gradient are read between neighbouring patterns or against a reference path. An extended pattern's skin versus centre is such a comparison: its quadrupole reads the tide and the trace reads density. The manuscript reads the wedged cavity's position-dependent mode response (SA-12, L113) as a comparison of neighbours, with the source's optical response on the same geometry as the comparator.

Define held moments m_j, magnetic field $\mathbf{B}$, reference rest energy E_0 outside every twist (a constant), a pattern's rest energy E where it sits in a twist, and induction energy E_{ind} including the work of inducing moments. The helical window (0.1c, P-5), its equation of motion the slow limit with each held moment at its settled value, is

$$E = E_0 + E_{\text{ind}} - \sum_j \mathsf{m}_j \cdot \mathbf{B}, \qquad \mathfrak{m} = \frac{E}{E_0}, \tag{19}$$

$$\mathcal{M} = \frac{E}{c^2}, \qquad \mathcal{M}\frac{d^2z}{dt^2} = -\partial_z E. \tag{20}$$

Here the clock factor belongs to the pattern. Patterns with different held and induced moments summed per unit energy fall differently along the field gradient; gravitational universality of free fall stands in its own window. A uniform twist turns a held moment and pushes nothing. Its reading compares neighbours, different patterns at one point or a reference path; copies of one pattern turned alike carry no pointwise reading of that twist. No moment is assigned gravitational compactness to obtain its magnetic push.

1.5 Mass, energy and the bounded density input

The I-5 confinement mode is u_q; the chart-position argument is $\mathsf{t}_{\text{chart}}$, the core's chart argument distinguished from physical time t. Its support, boundary, strand count and orientation are the already defined Ω, B, n, χ. The confinement eigenproblem and mass reading of I-5 are

$$D(\Omega, B; n, \chi, \mathsf{t}_{\text{chart}})u_q = \omega_q u_q, \qquad m_q c^2 = \hbar\omega_q. \tag{21}$$

No form of D, its domains, boundary data or spectrum is written here (O-9). In the manuscript's reading, the exciton is an eigenmode of the polymer segment's own support, not a constituent placed in a separate box (SA-79, L492). Electron patterns are $n = 3$ braids (U-07). Motion within one braid class changes confinement; changing class requires rebraiding. The generation route remains an open fork, and no generation identity, mass formula, anchor radius or absolute particle address enters.

The mass ledger (I-7, 0.5) counts rest mass M, non-rest stored energy E_{st}, pressure work PV and separately accounted thermal radiation once each:

$$\mathcal{M} = M + \frac{E_{\mathrm{st}}}{c^2} + \frac{PV}{c^2} + \frac{aT^4V}{c^2}, \qquad a = \frac{4\sigma_{\mathrm{SB}}}{c}. \tag{22}$$

The absorbed pump enters E_{st}/c^2 once as reservoir energy, condensate energy and film heat remaining after absorption, not again as a pump term. LC stored electric and elastic energies enter E_{st}/c^2 once under the AC drive. Thermal radiation enters aT^4V/c^2 and is excluded from that stored-energy entry. Pressure compression and exchange or interaction compression change the packing and the same ledger; direct pressure work enters PV/c^2. A splitting, blueshift, detuning or linewidth reads these channels rather than supplying a duplicate channel. Gravitational binding is read from the solved geometry, never added as local stress. The fixed-radius radiation partial has positive temperature sign; total change includes expansion, heat capacity and pressure work. No total thermal sign is assigned from that partial.

2 System chart and observation regions

Define local density ρ_{loc} and a nonnegative probe weight $\mathcal{W}$ with a finite, positive integral over the physical support. An interior datum samples a profile-weighted mean, not a point value:

$$\langle \rho_{\mathrm{loc}} \rangle_{\mathcal{W}} = \frac{\int_{\mathrm{support}} \mathcal{W}(\mathbf{x}) \rho_{\mathrm{loc}}(\mathbf{x})\, d^3\mathbf{x}}{\int_{\mathrm{support}} \mathcal{W}(\mathbf{x})\, d^3\mathbf{x}}. \tag{23}$$

This definition supplies no emission-to-omnium conversion (O-4). Core 0.6's local profile is "densest at the skin on both branches"; the centre is dilute. This statement concerns local density, not a uniform-volume proxy and not the brightness of an emission image.

System / probe	Chart or weight	Reading
Whole microcavity	Exterior gravitational window, independently fixed mass and field radius	A-1 enters the same-stress curvature; no optical fit constructs its mass.
Bound material pattern	Interior support with measured skin	A-1 local profile; no physical-radius transfer to the gravitational fold.
Photoluminescence	Emission-weighted pump spot and collection aperture	Dispersive mass, intensity, energy, linewidth and noncondensed-tail fit.
Fourier contrast	Imaged area and shot ensemble	Fourier peak ratio; amplitude/power convention remains unspecified.
Phase histogram	Equal weight over realizations	Reconstructed relative phases, without a reconstructed time trajectory.
Absorption	Illuminated polymer film	Fitted peak and width, separately for each proposed isotope film.
Reflectivity	Illuminated spot and collection aperture	Dip energies and polarization; source spot approximately 10 µm (SD-041, L515).
Interferogram	Condensate area in both Michelson arms	Spatial coherence in the source's separate zero-voltage experiment (SA-99, L626).

3 Observation map

Each table row states the source class and its locus. Supplementary figures and cited earlier works supply no additional observations here.

Source anchor	Record and verb class	FDT use
Fig. 2; SA-17, L130	Fitted splitting 93 meV; SA-18, L134: fitted $\approx 5.5\%$ exciton fraction.	Source-input identity map; no core amplitude.
Fig. 2; SA-23, L166	Reported threshold $95\,\mu\mathrm{J\ cm^{-2}}$; SA-26, L170: blueshift 4 meV.	Drive level and driven response kept separate.
Eq. 1; SA-36, L199	Fitted $\mathsf{d}_{\mathrm{HV}} = -1.3$ meV, $\mathcal{A}_{\mathrm{RD}} = 2.7$ meV µm.	Effective mode geometry, no fitted curvature ratio.
Fig. 3; SA-40, L219	Reported peak $2k_0 \approx 2.1\,\mu\mathrm{m}^{-1}$.	Two figures; reciprocal stripe spacing.
Fig. 3; SA-42, L233; SA-44, L239	Estimated density contrast 2.2%; reported polarization contrast 40%.	Distinct observables and conventions.
Eq. 3; SA-51, L279; SD-013, L286; SA-52, L289	Measured linear degree 16%, analytic 23%, circular model degree $\approx$ 80% under the equilibrium premise.	No reconstruction from absent masses or pure-state identity from these prints.
Fig. 4; SA-47, L268; SA-48, L271	Estimated width $\approx 0.5\,\mu\mathrm{m}^{-1}$ and printed bound $\approx 12\,\mu$m; fitted 313 ± 45 K.	Width estimate and noncondensed-tail fit, with different weights.
Fig. 4; SA-56, L372; SA-59, L384	Near-uniform caption histograms; 500 realizations in the text.	Relative-phase ensemble, not an unprinted uniformity test.
Fig. 5; SA-65, L408; SA-68, L415	Reported uncertainty on the vortex position of the order of the period of the stripes; vortices observed in about 10%, pump dependent.	Fringe-phase defects; no measured circulation or magnetic signal.

Define the source's circular-basis Hamiltonian by the renamed quantities in the guard. Equation 1 reads (SA-28, L170; SD-018, L172)

$$\mathcal{H}_{\mathrm{RD}} = \frac{\hbar^2 k^2}{2\mathsf{M}_{\mathrm{pol}}}\mathbb{1} + (\mathsf{d}_{\mathrm{HV}} + \mathsf{b}_{\mathrm{HV}} k^2)\hat{\mathsf{s}}_x + 2\mathcal{A}_{\mathrm{RD}} k_x \hat{\mathsf{s}}_z. \tag{24}$$

Every term has energy dimensions: the SOC coefficient has energy times length; the mass-difference coefficient has energy times length squared. Source Eq. 2 prints a dimensionally inconsistent mass power under its radical (SA-37, L272; SG-04, L273); it is neither repaired nor evaluated. The source prints no effective masses from which to reconstruct its minimum or Stokes degree. The Rabi fit uses photonic energies and masses from a Berreman calculation (SA-34, L195), after matching LC length and tilt to the source dispersion (SA-84, L508). Its 93 meV value is chosen for correspondence with the same mass–detuning data (SA-95, L587). This cluster is the identity map at the source's fit precision; it corroborates no invariant. A failure of the supplied model to return its own mass and energy inputs falsifies that identity reading.

The distinct two-damped-oscillator fit uses coupling 90 meV (SA-89, L537) and damping difference 70 meV (SD-029, L539). Those quantities are not the collective fit's splitting or its single-exciton coupling. At zero detuning the source's condition "If the broadening is larger than 90 meV" leads to the weak-coupling regime with degenerate real parts (QL-293–QL-296, L541–L544; SA-90). It is an interior detuning condition, not an endpoint of a curvature chart. The source's simulated photonic mass changes by approximately 19% (SA-87, L529); its sentence says "This simulation proves that the much bigger mode effective mass change observed in Fig. 2 can be explained solely by exciton-photon coupling" (QL-284–QL-286, L529–L531). The verb remains the source's and the quantity remains simulated.

Define exciton–photon detuning d_{ep}, a reconstructed lower-band photon gap $\mathcal{J}_{\mathrm{gap}}$, and reconstructed exciton share j_{ex}. The two-oscillator eigenvalues give

$$\mathcal{J}_{\mathrm{gap}} = \frac{\sqrt{\mathsf{d}_{\mathrm{ep}}^2 + \mathcal{E}_{\mathrm{R}}^2} - |\mathsf{d}_{\mathrm{ep}}|}{2}, \tag{25}$$

$$\mathsf{j}_{\mathrm{ex}} = \frac{1}{2}\left(1 - \frac{|\mathsf{d}_{\mathrm{ep}}|}{\sqrt{\mathsf{d}_{\mathrm{ep}}^2 + \mathcal{E}_{\mathrm{R}}^2}}\right). \tag{26}$$

On $\mathsf{d}_{\mathrm{ep}} = -190$ meV (SD-008, L172) and $\mathcal{E}_{\mathrm{R}} = 93$ meV (SA-17, L130), these reconstruct $\mathcal{J}_{\mathrm{gap}} \simeq 11$ meV and $\mathsf{j}_{\mathrm{ex}} \simeq 5\%$ at the source's displayed precision (SA-25, L171; SA-27, L170). These derived identities use no independent FDT input and corroborate no invariant. The rounded values agree with those source prints; the separate $\approx 5.5\%$ fit (SA-18, L134) and model interval 5–10% (SA-94, L577) remain separate.

The low-density source reading is partial pinning: for smaller condensate densities (close to threshold) the source finds "both theoretically and experimentally the stripes to be partly pinned by disorder" (QL-018–QL-020, L92–L94; SA-08), and the low-density regime "shows a preferential phase corresponding to a partial pinning of stripes" (QL-193–QL-194, L393–L394). The source writes that the estimated stripes contrast (SA-42, L233) is "three times more than the expected theoretical value, demonstrating the occurrence of a moderate pinning mechanism, either by the pump itself or by the disorder potential" (QL-138–QL-142, L233–L237). The caption calls high-density histograms "near-uniform" (SA-56, L372); the text says that the phase in the high-density regime "exhibits uniform distribution in both sample '2' and sample '3', which suggests the absence of pinning and fully demonstrates the spontaneous breaking of translational invariance" (QL-370–QL-373, L387–L390). The low-density panel's condensate density is approximately four times smaller (SD-017, L386), whereas the data correspond to a change in the pump density by only 10–20% (SA-62, L396). The source writes that "for lower condensate densities, the contrast does not decrease further after averaging of about 10 realizations" (QL-208–QL-209, L409–L410; SA-66). These statements retain their different scopes.

The source simulates condensation (SA-70, L430), "using the parameters of the polariton dispersion determined from the experimental results presented in Fig. 3" (QL-349–QL-351, L675–L679), with relaxation 0.02, reservoir potential 0.1 meV and width 18 µm (SA-107, L680). The caption interaction and disorder are 1 and 0.5 meV (SA-58, L376); the Methods disorder has 0.3 meV rms and 7 µm correlation length (SA-104, L657). They are distinct prints, not interchangeable disorder estimates. The continuous-wave bogolon dispersion is explicitly unmeasured (SA-72, L449), and the vortex-number scaling is presented elsewhere (SA-73, L461). Neither supplies a new experimental test here. The cluster is an in-sample identity map at the printed parameter precision; it corroborates no invariant. A discrepancy of simulated versus source histograms on those same inputs falsifies its stated reproduction.

4 Cone-position translation and the experimental reading

Define a projected amplitude A, imaginary unit i, and initial helical phase ϕ_0. The quantum-face paragraph of I-4 is quoted whole:

> QM is helical geodesics on truncated density cones. The wavefunction $\psi = Ae^{i\phi}$ is the projection of a helix onto the plane normal to the cone axis; "superposition" is ignorance of the helical phase ϕ_0 at observation. The universe is deterministic; there are no probability amplitudes.

The source says "The observation of stripes therefore directly proves that" the relative phase "is constant over the condensate's spatial and temporal extension" (QL-175, L287; QL-368–QL-369, L288–L289; SA-53). In the manuscript's reading this is phase fixation across a macroscopic pattern. Near-uniform phase histograms are the image of ignorance of the initial helical phases; the origin reading is stated once in the convergence statement. This is experimental evidence of I-4's quantum-face concept in the manuscript's reading, with the source's integrated-image precision. It uses the identity map and corroborates no invariant; loss of the reported relative-phase coherence would falsify that reading of these images.

Core 0.1a states:

> The global optimisation is solved at every step, from the state the system is in; the expected behaviour is not necessarily the evolving system's optimum. Events do not commute, and a process run backward is never the mirror of the forward event. Responses are system-wide and many-to-many (I-5b's reclosure is one), never one-to-one, particle by particle; I-1's pair expression stays exact on its declared domain (I-1, I-4).

One relative phase places the stripes across the condensate in each shot. The source's defect "which spontaneously appears in the condensation process" (QL-204, L398) is settled with it in the manuscript's reading. The source's cited account remains that "Random creation of vortices typically takes place during the condensation process" via the Kibble–Zurek mechanism (QL-197–QL-199, L393–L395; SA-63). "The core names no objective for the optimisation" (0.1a); the source's Gross–Pitaevskii, gain and relaxation terms remain its method. This is experimental evidence of one settlement in the manuscript's reading; the identity map at image precision corroborates no invariant. A spatially incoherent phase ensemble within each reported stripe image would falsify this application.

P-2 states:

> Readings: eigenstates, phonon modes and orbitals are nodal patterns of the driven density field; bonding and Cooper pairing are shared scattering-free nodal channels; localisation is trapping in disconnected nodal pockets; condensation, crystallisation and percolation are global eigenmode snaps of the standing-wave network. By I-2 the same nodal structure appears in every carrier window; mode geometry is set by the boundary conditions (the clamps, P-3), not by the medium.

The source writes "Stripes are the result of the interference between the two k-components of the condensate" (SD-070, L279; SD-071, L280). The stripes period is "theoretically given by" π/k_0 (SD-012, L291); the k-space distance between the two peaks of the condensate emission "versus voltage is shown in Fig. 4C" (L261–L264; QL-149, L265; SA-46). The mirrors and the LC optical axis that voltage turns in the yz plane (QL-026–QL-029, L106–L109) set those boundary conditions in the manuscript's reading. P-2's medium is the omnium; the source's LC is its material pattern. The stripe phase in the source's microcavity "allowing the achievement of room-temperature supersolidity for a quantum fluid of light" (QL-003–QL-004, L20–L21; SA-02), supersolidity being "a peculiar state of matter, which, in addition to the superfluid behavior, shows periodic density modulation typical for crystals" (SA-01, L18; QL-358, L19), is experimental evidence of condensation and crystallisation as one snap in this reading. The source's superfluid qualifier in the abstract and pinning reading remain intact. This identity map at the source's wave-number precision corroborates no invariant; failure of the observed stripe period to follow the reported two-mode interference falsifies it.

P-4's rule and its flow-direction qualification are quoted:

> Every density cone carries a flow direction—the cone's own circulation sense, the way its helical geodesics wind about its axis, intrinsic and fixed once for all; same flow direction → repulsion; opposite flow direction → attraction. Chirality is one carrier of a flow direction, not the only one.

The manuscript reads each circular component's rotation sense as its flow direction. The source cites same-spin and opposite-spin interaction constants, with $\mathfrak{g}_2 < 0$ and $|\mathfrak{g}_2| \ll \mathfrak{g}_1$ for negative detunings (SA-106, L672), but sets $\mathfrak{g}_2 = 0$ in its model (SD-066, L674). In this reading the same-sense constant repels and the opposite-sense one attracts. This sign reading is a cited input, never an experimental datum. The pairs are those the condensate's one settlement joins where components overlap; P-4 says "never pair by pair from a table of every pair". The magnitude is an I-1 derivation with a declared kernel; none enters here (O-5, O-6). The identity reading corroborates no invariant, and an opposite sign in that specified joined-pair channel would falsify its identification.

P-5's last two sentences state:

> Imposing a physical twist (torsion, helical geometry) on a material is establishing a magnetic field; mechanical vorticity and magnetic moments are different grade projections of one density-gradient topography, with no carrier exchange (I-2). Quantitative twist → moment forms are derived in-manuscript through I-1/I-2 with a declared kernel.

The source writes that the RDSOC in microcavities with strong birefringence "stems from the chirality of the system as a whole" (L583–L584; SA-97, L587; QL-318, L588): if one represents the two mirrors

and the optical axis by three lines, the structure that they form, from the point of view of a beam with a nonzero in-plane wave vector, "looks like a letter Z", different from its mirror image (QL-318–QL-319, L588–L589; QL-386–QL-387, L591–L592). In the manuscript's reading this is the cavity geometry acting on the stroke's spin, whose radius and spin relation were quoted above. LC rotation in one yz plane between antiparallel orienting layers (QL-027, L107; SD-037, L501) is no physical twist. The first clause of P-5's twist sentence, silent on an untwisted material, establishes by twist no magnetic field in this source cavity in the manuscript's reading. The minima stay degenerate. This experimental-evidence positioning is the identity map and corroborates no invariant; a resolved additional hand-odd splitting belongs to the new twisted apparatus below.

P-5 also states "vortex lines are bivector topological defects". The manuscript reads the fringe vortex of Fig. 5 as such a defect; its winding lies on the helical phase axis at fixed field identity. It is neither a braid count nor an experimental magnetic moment. At the source's uncertainty on the vortex position, of the order of the period of the stripes, this is the identity map and corroborates no invariant; absence of phase winding at the reported fork would falsify that identification.

Define helical phase ϕ_h, orthogonal basis vectors e_1, e_2, and the phase-plane bivector $\mathcal{B}_{\text{phase}} = e_1 e_2$, with square minus unity, distinct from the magnetic vector $\mathbf{B}$. The cylindrical lift of the projected oscillator is

$$\phi_h(t) = \phi_0 - \omega t, \qquad i \longleftrightarrow \mathcal{B}_{\text{phase}}, \qquad e^{i\phi_h} \longleftrightarrow e^{\mathcal{B}_{\text{phase}}\phi_h}. \tag{27}$$

The exponent is dimensionless. This is the single-angle phase rotor, distinct from a half-angle spinor rotor. Projection fixes a phase, while occupation and winding preserve field identity; no strand count is attached to the optical longitudinal mode. These are phase-axis translations, not absolute positions on the confinement axis.

5 Prospective predictions

The apparatus choices and noise models in this section are external, illustrative-assumed inputs U-08–U-88. Each comparison removes a shared conventional response or sets that response to its specified conventional limit. The remaining input is an additional source or constitutive response; a chart change alone supplies no divergence. Independent Gaussian reading and fit errors and independent fair order coins define the numerical design model (U-86). Correlated systematic terms are propagated before taking the relevant mean; independent errors are not substituted for terms that a contrast cancels. For any contrast vector $\boldsymbol{\upsilon}$ and measurement covariance $\boldsymbol{\Sigma}$, define its variance as $\boldsymbol{\upsilon}^{\mathsf{T}}\boldsymbol{\Sigma}\boldsymbol{\upsilon}$. For two readings the difference uncertainty is therefore the square root of their variance sum minus twice their covariance. The symbol k_{test} denotes a test's standard error; z_{crit} denotes its critical multiplier. The resolved scale is $\mathsf{z}_{\text{crit}}\mathsf{k}_{\text{test}}$, never the instrument resolution by itself.

5.1 T-1: twist and the two lower-band minima

DC-1 discriminates SA-03, where the source writes "We demonstrate exciton-polariton condensation in the two distinct degenerate minima of the dispersion created by the LC-induced Rashba-Dresselhaus SOC" (SA-03, L23; QL-006, L24): no energy-difference bound accompanies that statement. P-5 supplies a new physical twist source in the following external apparatus. This is an existence prediction; the core's quoted twist-to-moment clause supplies neither magnitude nor sense.

Use sixteen microcavities of the source design, eight of each hand at equal chiral-dopant concentration, with LC2091* carrying one 90° twist between layers rubbed at that angle, and four untwisted controls with antiparallel layers (U-08, U-09). The total is $16 + 4 = 20$ cavities (U-08). Use the source's white-light reflectivity geometry in wave-vector space (SD-040, L513; SD-072, L521), with no pump. Fit each minimum's reflectivity dip independently of the comparator. Assign the positive and negative labels by circular polarization degree, using polarization-resolved reflectivity; the source describes the minima as elliptically polarized with opposite circular degrees (QL-162–QL-163, L275–L276).

Each cavity is mounted with its thirteen-layer DBR toward the objective at both 0° and 180° about the cavity normal, the minima's axis along the spectrometer slit (U-10). A fair coin is drawn before the first mounting of each cavity, randomising the sign of the spectrometer energy–angle tilt drift between mountings (U-11). Define E_+, E_- as the two polarization-labelled energies and q_E as the per-cavity contrast:

$$\mathsf{q}_\mathrm{E} = \tfrac{1}{2}\big[(E_+ - E_-)_0 + (E_+ - E_-)_{180}\big]. \tag{28}$$

Each valley occupies opposite laboratory sides in the two mountings. The laboratory-fixed tilt cancels; the sample splitting stays.

In the manuscript's reading of P-5 the field lies along the twist axis, its sense set by the hand relative to the structure's own polar direction along that axis, the fifteen-to-thirteen-layer DBR order (SD-069, L497). The consensus magneto-optical response couples that additional field to the circular components; its independently calibrated response must be nonzero for the energy test. No numerical charge-to-I-1 map enters (O-6). The conventional comparator is zero: the consensus premise of reciprocity for a nonmagnetic linear cavity gives one eigenvalue at opposite wave vectors, including reciprocal natural optical activity. This premise is the comparator's, not FDT's account of an event run backward.

Define $\overline{\mathsf{q}_\mathrm{E}}$ as a group's arithmetic mean. Roman R and L label right and left hands. Define $\mathfrak{d}_\mathrm{h,E}$ as their difference and N_perm as the number of balanced relabelings, and p_E as their two-sided tail fraction:

$$\mathfrak{d}_\mathrm{h,E} = \overline{\mathsf{q}_\mathrm{E}}(\mathrm{R}) - \overline{\mathsf{q}_\mathrm{E}}(\mathrm{L}), \qquad \mathsf{N}_\mathrm{perm} = \binom{16}{8} = 12870. \tag{29}$$

Detection: two-sided $p_\mathrm{E} \le 0.0027$ (U-18), exact under the null's exchangeability. The attainable size is $34/12870 \simeq 0.0026$ (U-20). Define $\mathsf{e}_\mathrm{0,E}$ as the excluded per-hand splitting. Exclusion: a splitting of 25 µeV or more per hand (U-16) is excluded when the contrasts shifted against the hand by that size put the right-minus-left contrast in the lower tail, and the opposite shifts put it in the upper tail, each one-sided at $p \le 0.00135$ (U-19). Explicitly the first shifted groups are $\mathsf{q}_\mathrm{E} - \mathsf{e}_\mathrm{0,E}$ for right and $\mathsf{q}_\mathrm{E} + \mathsf{e}_\mathrm{0,E}$ for left; the second reverses both signs. The exact one-sided size is $17/12870 \simeq 0.0013$ (U-20). Inconclusive otherwise. Attribution: a detection is read as the twist's field, with the four untwisted controls' contrasts reported beside it; the first clause of P-5's twist sentence, silent on an untwisted material, establishes by twist no magnetic field in those controls in the manuscript's reading.

The assumed errors are 10 µeV per minimum per mounting (U-12), 5 µeV tilt reset per mounting (U-13), and 3 µeV tilt drift with the coin's sign (U-14). Define k_qE as per-cavity scatter and k_hE as scatter of the hand difference. The reset acts on each mounting's energy difference and the drift changes that difference once between mountings, so

$$\mathsf{k}_\mathrm{qE}^2 = 10^2 + \frac{5^2}{2} + \frac{3^2}{4}, \qquad \mathsf{k}_\mathrm{hE} = \mathsf{k}_\mathrm{qE}\sqrt{\frac{1}{8} + \frac{1}{8}}. \tag{30}$$

These give estimated scatters 10 and 5 µeV, respectively, at the one-figure precision of the assumed errors. The numerical design benchmarks (U-21, U-22, U-35, U-36) are a null rate 0.00275 ± 0.00017 in 100000 trials and power 0.531 at 10 µeV per hand; the unrounded scatter benchmarks are 10.7 and 5.4 µeV. The corresponding exclusion benchmarks are 1.000 with no effect, false exclusion 0.0012–0.0016 at either signed bound with Monte Carlo error 0.0001, and none at 1.5, 2 and 3 times the bound in 100000 trials each. These are assumed design benchmarks, not source data. The executed design-model rates and their simulation uncertainty are given in the table below after the five tests.

For the explicit test point, take the assumed per-hand signal at the exclusion size; replacing the twist input by its conventional zero changes the predicted hand contrast from 50 to 0 µeV. Define $\mathsf{z}_\mathrm{perm,E}$ as the null median of the balanced-permutation critical contrast divided by the scatter of the hand difference for the stated balanced design. That critical contrast bounds the upper tail of the detection rule's two-sided test and is the 17th largest of the 12870 relabeled contrasts. Under the design model, $\mathsf{z}_\mathrm{perm,E} \simeq 2.6$, so the resolved scale is $\mathsf{z}_\mathrm{perm,E}\mathsf{k}_\mathrm{hE} \simeq 10$ µeV (U-86) at the one-figure precision of the assumed errors. Single-channel scope: reversing hand reverses the added sample field; reciprocal chirality is zero in the comparator; laboratory tilt is cancelled; reset and coin-randomised drift have zero signed mean.

5.2 T-2: nonreciprocal rotation of a twisted LC cell

DC-2 discriminates SA-98, the source's tilted-axis half-wave-plate account (L595), which contains no nonreciprocal rotation measurement. P-5 supplies an additional field in a physical twist, read through the cell's nonzero magneto-optical response.

Use sixteen 2 µm LC2091* cells, eight per hand at equal chiral-dopant concentration with orienting layers rubbed at 90° on both plates (U-23, U-24, U-25), and four untwisted controls with antiparallel orienting layers (U-23; SD-037, L501), each between one ITO-coated and one uncoated quartz plate. Each cell is read on one separate gold back reflector. A zero-area-loop Sagnac interferometer at 1550 nm (U-26) reads the cell's double-pass nonreciprocal rotation and is blind by construction to reciprocal birefringence and natural optical activity.

Read each cell normally with the ITO plate facing the beam, and turned over on the reflector about the ITO plate's rubbing direction so its ITO-to-uncoated direction reverses against the beam. A fair coin drawn before the first reading randomises the sign of offset drift between readings (U-27). Define the measured Kerr rotation ϖ_{K} and per-cell contrast q_{K}, and the right-minus-left hand contrast $\mathfrak{d}_{\mathrm{h,K}}$:

$$\mathsf{q}_{\mathrm{K}} = \tfrac{1}{2}(\varpi_{\mathrm{K,normal}} - \varpi_{\mathrm{K,turned}}), \tag{31}$$

$$\mathfrak{d}_{\mathrm{h,K}} = \overline{\mathsf{q}_{\mathrm{K}}}(\mathrm{R}) - \overline{\mathsf{q}_{\mathrm{K}}}(\mathrm{L}). \tag{32}$$

The fixed instrumental offset and Earth's field along the beam cancel. The manuscript's axis reading is ITO-to-uncoated, its field sense set by the hand relative to that polar direction. The conventional comparator is zero: a nonmagnetic layer gives no nonreciprocal rotation, the consensus premise. The measured Sagnac rotation is independent of that comparator input.

Detection: the two-sided permutation test over the same balanced assignments rejects at $p \le 0.0027$ (U-18), with exact size 34/12870 (U-20). Define $\mathsf{e}_{0,\mathrm{K}}$ as the excluded rotation per hand. Exclusion: a rotation of 100 nrad or more per hand (U-33) is excluded when $\mathsf{q}_{\mathrm{K}} - \mathsf{e}_{0,\mathrm{K}}$ on right and $\mathsf{q}_{\mathrm{K}} + \mathsf{e}_{0,\mathrm{K}}$ on left give a lower-tail contrast, and the reverse shifts give an upper-tail contrast, each one-sided at $p \le 0.00135$ (U-19; exact size 17/12870, U-20). Inconclusive otherwise. Attribution: a detection is read as the twist's field, with the four untwisted controls' contrasts reported beside it; the first clause of P-5's twist sentence, silent on an untwisted material, establishes by twist no magnetic field in those controls in the manuscript's reading.

The assumed reading error is 20 nrad (U-28), offset reset 50 nrad per reading (U-29), fixed laboratory term 100 nrad (U-30), and coin-signed offset drift 10 nrad (U-31). Define per-cell scatter k_{qK} and hand scatter k_{hK}. Cancellation followed by propagation gives

$$\mathsf{k}_{\mathrm{qK}}^2 = \frac{20^2 + 50^2}{2} + \frac{10^2}{4}, \qquad \mathsf{k}_{\mathrm{hK}} = \frac{\mathsf{k}_{\mathrm{qK}}}{2}. \tag{33}$$

The one-figure estimated scatters are 40 and 20 nrad. The supplied numerical benchmarks are null rate 0.0026 ± 0.0002 in 100000 trials, scatter 38 nrad per cell and 19 nrad for the hand difference, and power 0.665 at 40 nrad per hand (U-34). The exclusion benchmarks are 1.000 with no effect, false exclusion 0.0012–0.0016 at either signed bound, Monte Carlo error 0.0001, and none at 1.5, 2 and 3 times it in 100000 trials each (U-35, U-36). At the assumed exclusion-size test point the predicted hand contrast is 200 nrad; its conventional-source replacement is 0 nrad. Define $\mathsf{z}_{\mathrm{perm,K}}$ as the null median, under the design model, of the detection rule's permutation critical contrast divided by the hand scatter: $\mathsf{z}_{\mathrm{perm,K}} \simeq 2.6$, so the resolved scale is $\mathsf{z}_{\mathrm{perm,K}}\mathsf{k}_{\mathrm{hK}} \simeq 50$ nrad (U-86) at the one-figure precision of the assumed errors. Single-channel scope: sample hand changes the added signal sign; reciprocal optical activity contributes zero; fixed laboratory rotation cancels; resets and coin-signed drift enter the propagated scatter.

5.3 T-3: isotope response of the fitted Rabi splitting

DC-3 discriminates SA-35, the collective-coupling input to the source's fit (L198), which gives no isotope comparison. I-7 supplies the added density channel. Its discriminator is quoted whole:

> For purely density-coupled equilibrium observables, a heavier isotope → larger R_s → higher α → larger response—opposite in sign to conventional reduced-mass scaling.

Here the manuscript reads larger response as a larger Rabi splitting; the observable prediction rests on the stated sensitivity and the competing channels below.

Use eight pairs of source-design microcavities (U-37), one member with MeLPPP synthesized from carbon-thirteen-enriched monomers, at least 99% on the backbone, and one from natural-abundance monomers (U-38). Use one route and one molar-mass target, fabricate each pair back to back in one deposition run, and measure it back to back within a day of filling (U-39). A fair coin drawn before each pair determines both orders, randomising the sign of run drift and MeLPPP ageing between measurements (U-40); the source's degradation scale is a few days to a few weeks (SA-14, L120). Extract each splitting independently through parabola fits to LPB masses and a Tavis–Cummings mass–detuning fit (SA-32, L188; SA-95, L587), using each film's own exciton width from absorption (SA-78, L491).

For the following quotation, δ denotes variation, O an observable, x_i a channel input and Π a product. I-7 Discipline 2 is quoted whole, with its generic channel variable confined to this quotation:

> A sign prediction competing with geometric, electronic or inertial channels is written as a sensitivity-weighted sum $\delta \ln O = \sum_i S_i \delta \ln x_i$ with every S_i defined (held-fixed variables stated). The density-channel input sign is the FDT discriminator; the observable sign is $\mathrm{sgn}(\Pi S_i)$ and stays conditional until the sensitivities are established.

In that generic sentence O is an observable and x_i its channel input; below every actual input has its own symbol. Define S_{dens} as the derivative of log splitting with respect to log exterior compactness at fixed pressure, geometric field radius, packing and the other channel variables. It is evaluated for the whole cavity's independently determined A-1 gravitational window. The heavier substitution increases its mass input at those fixed quantities; the derivative's positive sign is an independently testable response premise. Define $\alpha_{\mathrm{ext,nat}}$ and $\alpha_{\mathrm{ext,heavy}}$ as the natural and heavy isotope compactness endpoints. A finite density contribution, $\mathfrak{a}_{\mathrm{R}}$, is the path integral

$$\mathfrak{a}_{\mathrm{R}} = \int_{\ln \alpha_{\mathrm{ext,nat}}}^{\ln \alpha_{\mathrm{ext,heavy}}} S_{\mathrm{dens}}\, d \ln \alpha_{\mathrm{ext}}. \tag{34}$$

No local derivative multiplied by a finite span replaces this amplitude. Logarithms of dimensional observables denote ratios to the same fixed reference unit, which cancels in every finite difference. The mass coordinate is determined independently, never from the splitting that it is used to predict. I-6 maps the independently changed odds by Eq. (9); logarithmic and fractional changes stay distinct.

Define V_{zp} as the zero-point volume contribution, $\mathsf{F}_{\mathrm{osc}}$ as oscillator strength, and h_{HR} as the Huang–Rhys factor. The symbol Δ denotes a finite change. The conventional comparator sums the following assumed finite log shifts. Each coefficient is the log-splitting derivative with all other listed variables fixed. Define $\mathfrak{c}_{\mathrm{R}}$ as their sum and $\mathfrak{r}_{\mathrm{film}}$ as the residual corrected-film contribution.

$$\mathfrak{c}_{\mathrm{R}} = -\tfrac{1}{2}\Delta \ln V_{\mathrm{zp}} + \tfrac{1}{2}\Delta \ln \mathsf{F}_{\mathrm{osc}} - 0.020 \mathsf{h}_{\mathrm{HR}} + \mathfrak{r}_{\mathrm{film}}. \tag{35}$$

Channel	Assumed input and provenance	Splitting sign
Zero-point volume	$-0.0003 \le \Delta \ln V_{\mathrm{zp}} \le 0$ (U-41)	Nonnegative.
Oscillator strength	$\lvert\Delta \ln \mathsf{F}_{\mathrm{osc}}\rvert \le 0.002$ (U-42)	Either sign.
Reduced mass	$0 \le \mathsf{h}_{\mathrm{HR}} \le 0.5$ (U-43); coefficient -0.020 (U-44)	Nonpositive.
Residual density / thickness	$\lvert\mathfrak{r}_{\mathrm{film}}\rvert \le 0.005$ (U-45)	Either sign.
Added density	Independent mass input at fixed pressure, radius and packing	Positive input; output sign requires positive sensitivity.

The reduced-mass scaling of the main excitonic peak's zero–zero share gives $-0.020\,\mathsf{h}_{\mathrm{HR}}$ in log splitting, carbon-thirteen lowering the C=C stretch by $\frac{1}{2}\ln(13/12) \simeq 0.040$ in its logarithm at fixed reorganization

energy (U-38, U-44): -0.010 to 0 for a factor at most 0.5, from each film's own absorption (U-43, U-44). Summing endpoints gives the outward comparator interval $[-0.02, +0.01]$ (U-46); no sign is assigned by omitting a competing channel.

Define the paired log differences $\mathfrak{d}_{\mathrm{R},j}$, their mean $\overline{\mathfrak{d}}_{\mathrm{R}}$, sample deviation k_{R}, upper comparator endpoint $\mathfrak{e}_{\mathrm{R},+}$, and statistic $\mathfrak{t}_{\mathrm{R}}$:

$$\mathfrak{d}_{\mathrm{R},j} = \ln \mathcal{E}_{\mathrm{R},j}(\text{heavy}) - \ln \mathcal{E}_{\mathrm{R},j}(\text{nat}), \tag{36}$$

$$\mathfrak{t}_{\mathrm{R}} = \frac{\overline{\mathfrak{d}}_{\mathrm{R}} - \mathfrak{e}_{\mathrm{R},+}}{\mathsf{k}_{\mathrm{R}}/\sqrt{8}}. \tag{37}$$

Detection: the one-sided Student test rejects at 0.00135, with seven degrees of freedom and critical value 4.530 (U-50). Exclusion: an added FDT-sign density contribution of 0.08 above the interval's lower end is excluded when the one-sided statistic below its absolute bound 0.06 rejects at the same rate (U-52). Inconclusive otherwise. Attribution: a detection is read as the density channel when it survives correction of each pair difference by its measured chromophore-density difference, from exciton absorbance per unit thickness using the source's absorption method (SA-78, L491).

Independent cavity scatter and fit error are each 0.01 in log splitting (U-47, U-48); run and ageing drifts are each 0.005 with the same pair coin's sign (U-49). Their common sign is retained in the sum before squaring. Define anticipated pair scatter $\mathsf{k}_{\mathrm{pair,R}}$:

$$\mathsf{k}_{\mathrm{pair,R}}^2 = 2(0.01^2 + 0.01^2) + (0.005 + 0.005)^2. \tag{38}$$

The supplied benchmarks are null rate 0.0014 at the upper endpoint, below 0.00001 at the centre and none at the lower in 10000000 trials, Monte Carlo error 0.00001; doubled drifts give 0.0019 (U-51). Exclusion benchmarks are false exclusion 0.0014 at the bound, exclusion 0.90 with no added channel at the upper endpoint and 1.000 at the lower (U-53). At the illustrative lower-end comparator and added contribution 0.08, the predicted log difference is 0.06 and its ablated value is -0.02. The sufficient precision criterion is $4.530\mathsf{k}_{\mathrm{pair,R}}/\sqrt{8} \simeq 0.04$ (U-50); the added contribution exceeds it. These amplitudes are design test points, not core-calculated sensitivities.

5.4 T-4: isotope response of a witness-film index

DC-4 discriminates SA-82, the fitted background index (L499), which contains no isotope measurement. I-7 adds the same independently defined density input; the manuscript reads larger response as a higher optical index. This prediction rests on a declared positive index sensitivity.

Use eight witness-film pairs, each film spun on quartz in its associated cavity's deposition run and read back to back with the other film in the pair's coin order (U-54). Ellipsometry at 700 nm below exciton absorption is external (U-55). The source's index 1.7, extracted from the real-index dependence (SA-81, L498; SA-82, L499), is the comparator evaluation point (U-56), not a measurement at this probe wavelength. Define $\mathfrak{L}$ as the Lorentz–Lorenz function and J_{n} as the index sensitivity to its logarithm. Differentiation of the conventional relation gives

$$\mathfrak{L} = \frac{\mathfrak{n}^2 - 1}{\mathfrak{n}^2 + 2}, \qquad \mathsf{J}_{\mathrm{n}} = \frac{d\mathfrak{n}}{d\ln\mathfrak{L}} = \frac{(\mathfrak{n}^2 - 1)(\mathfrak{n}^2 + 2)}{6\mathfrak{n}}. \tag{39}$$

At the evaluation point $\mathfrak{n} = 1.7$, the source's two-figure $\mathfrak{n}_{\mathrm{BG}}$ (SA-82, L499), the derivative is 0.91 (U-60), at the two figures of that index. A finite shift uses the inverse function $\mathfrak{n} = \sqrt{(1 + 2\mathfrak{L})/(1 - \mathfrak{L})}$, or the path integral of J_{n}, not a local derivative promoted to a finite amplitude.

The conventional log-function inputs are zero-point number-density change $[0, +0.0003]$ (U-57), polarizability change $[-0.001, 0]$ (U-58), and packing residual ± 0.001 (U-59). The first is nonnegative, the second nonpositive and the third of either sign; all remaining variables are held fixed for each contribution. The resulting index interval is $[-0.0018, +0.0012]$ as the supplied comparator benchmark (U-61); the

exact inverse function and the local expansion agree at those printed figures. It is rounded outward to $[-0.002, +0.002]$ (U-61). Define $S_{\mathrm{n,dens}}$ as the derivative of log index with respect to log exterior compactness, with pressure, radius, packing and other channels fixed. The added finite log-index response is its path integral over the same independently determined isotope mass input; conversion to an index change uses the exponential exactly. Its positive input alone fixes no output sign.

Define pair index differences $\mathfrak{d}_{\mathrm{n},j}$, their mean $\overline{\mathfrak{d}}_{\mathrm{n}}$, sample deviation k_{n} and upper endpoint $\mathfrak{e}_{\mathrm{n},+}$. The statistic $\mathfrak{t}_{\mathrm{n}}$ is

$$\mathfrak{d}_{\mathrm{n},j} = \mathfrak{n}_j(\mathrm{heavy}) - \mathfrak{n}_j(\mathrm{nat}), \qquad \mathfrak{t}_{\mathrm{n}} = \frac{\overline{\mathfrak{d}}_{\mathrm{n}} - \mathfrak{e}_{\mathrm{n},+}}{\mathsf{k}_{\mathrm{n}}/\sqrt{8}}. \tag{40}$$

Detection: the one-sided Student test rejects at 0.00135 with seven degrees of freedom and critical value 4.530 (U-50). Exclusion: an added positive density contribution of 0.009 above the interval's lower end is excluded when the one-sided statistic below its absolute bound 0.007 rejects at the same rate (U-66). Inconclusive otherwise. Attribution: a detection is read as the density channel when it survives correction of each pair difference by its measured chromophore-density difference, from exciton absorbance per unit thickness using the source's absorption method (SA-78, L491).

Assume independent film scatter 0.001 (U-62), ellipsometric error 0.0005 (U-63) and coin-signed run drift 0.0005 (U-64). Define anticipated pair scatter $\mathsf{k}_{\mathrm{pair,n}}$ by

$$\mathsf{k}_{\mathrm{pair,n}}^2 = 2(0.001^2 + 0.0005^2) + 0.0005^2. \tag{41}$$

Supplied numerical benchmarks are null rate 0.00136 at the upper endpoint, none at the centre, in 10000000 trials with Monte Carlo error 0.00001; doubled drift gives 0.00145 (U-65). Exclusion benchmarks are false exclusion 0.00135 at the bound, exclusion 0.995 with no channel at the upper endpoint and 1.000 at the lower (U-67). At the illustrative lower comparator endpoint the added index change 0.009 gives predicted 0.007, versus ablated -0.002. The sufficient precision scale is $4.530\mathsf{k}_{\mathrm{pair,n}}/\sqrt{8} \simeq 0.003$ (U-50). The isotope volume, polarizability and packing channels remain in the comparator and the added finite density response exceeds that scale.

5.5 T-5: magnetic projection of condensate circulation

DC-5 discriminates SA-68, vortices "observed in about 10%" of experiments, with probability depending on pumping power (L415–L416, L458). The record supplies no winding-resolved magnetic measurement. P-5's "mechanical vorticity and magnetic moments are different grade projections of one density-gradient topography, with no carrier exchange (I-2)" supplies the additional source in the manuscript's circulation reading. I-3a's full projection clause is

> The deviation map $\nabla\mathcal{U}$ of a family of patterns splits into a trace (expansion: density, by continuity), an antisymmetric part (vorticity: the bivector grade, the mechanical circulation whose magnetic projection is that of P-5) and a symmetric trace-free part (shear: the tidal stretch and compression).

This is an existence prediction: it rests on that circulation reading and on an observable magnetic projection. No clause fixes its sign relative to winding or its magnitude without a response kernel (O-6).

Use the source-design microcavity under its single-shot RDSOC excitation (SA-74, L470; SD-047–SD-050, L467–L474). A weak external 700 nm transmission probe, outside the stop band and below exciton absorption, covers the condensate at a delay inside its pulse (U-68). A balanced polarimetric camera at 1 µm resolution reads Faraday rotation in a 1 µm diameter disc at the vortex core against an annulus centred 6 µm from it (U-69; disc convention fixed here). This is about two stripe periods, using $2\pi/2.1 \simeq 3.0\,\mu\mathrm{m}$ from the reported two-figure wave number (SA-40, L219; U-70), beyond the source's uncertainty on the vortex position, "of the order of the period of the stripes" (QL-206, L407; SA-65, L408). Locate each core after its shot from the interferogram's fork.

A single fringe dislocation is a vortex in one valley component. Read the circulation sign from global-phase winding at that core in a retroreflected Michelson interferogram, with inversion centre displaced from every core. This extends the source's method, demonstrated at zero voltage only, to RDSOC (SA-99, L626; SA-109, L670); the extension is external. Define winding $\mathfrak{w} = \pm 1$ and accepted count $\mathsf{N_w} = 2000$ per sign (U-71). The spontaneous sign is not assigned by the investigator. The planning budget is about $2 \times 2000/0.1 = 40000$ single shots (U-72), one figure from the source's approximate vortex frequency.

Define $\mathfrak{d}_\mathrm{w}$ as the mean disc-minus-annulus rotation at positive winding minus that at negative winding. Winding-even condensate rotation cancels. Define $\mathsf{C_w}$ as the conventional winding-odd contrast for exactly the same spatial weights. It includes the orbital moment driven in ITO and MeLPPP by absorbed angular-momentum flux, $\mathfrak{w}\hbar$ per absorbed photon, from measured absorbance at the condensate energy and momentum-relaxation times, and the winding-odd part of the condensate's own spin density at the core. The latter rests on the TE–TM SOC, called in the source's introduction the "most prominent SOC", which the source writes "is related to the transverse-electric/transverse-magnetic (TE-TM) nature of light modes" (L67–L71; SD-073) and its Eq. 1 omits: it couples a winding $\mathfrak{w}$ in one circular component to a winding two units away in the other and, at the valley's wave number k_0, to one a unit away, so the admixture of the opposite polarization at the vortex core differs between the two senses, the same way round in both components. Compute that winding-odd part from the fork's location error (U-75) and from the TE–TM and H–V terms about $\pm k_0$, read across k_y at each minimum with the source's reflectivity setup and its two sets of a quarter–wave plate, a half–wave plate, and a linear polarizer (SD-040, L513; SD-072, L521; SD-074, L522, L458): on the k_x axis the two terms enter as one sum, and the winding-odd part rests on the TE–TM term's diagonal linear polarization, which vanishes on the k_x and k_y axes. This defines an independently measured comparator, not a fitted residual.

Define the misread share $\mathsf{q_{mis}}$, its calibration error $\mathsf{u_{mis}}$, and dilution $\mathsf{a_{mis}}$. Assume $\mathsf{q_{mis}} = 0.02 \pm 0.005$, correctly read share 0.98 (U-76), so $\mathsf{a_{mis}} = 1 - 2\mathsf{q_{mis}} = 0.96$ (U-77), diluting signal and comparator alike. Define $\mathsf{u_C}$ as the comparator error, $\mathsf{u_w}$ as the propagated error of the subtracted comparator, and $\mathsf{v_\pm}$ as per-shot deviations measured from each winding group's shots, including misread binomial scatter. Define $\mathsf{k_w}$ as the full contrast standard error. With independent calibration and shot data,

$$\mathsf{u_w^2} = (\mathsf{a_{mis}u_C})^2 + (2\mathsf{C_w u_{mis}})^2, \tag{42}$$

$$\mathsf{k_w^2} = \frac{\mathsf{v_+^2}}{\mathsf{N_w}} + \frac{\mathsf{v_-^2}}{\mathsf{N_w}} + \mathsf{u_w^2}, \tag{43}$$

$$\mathsf{z_w} = \frac{\mathfrak{d}_\mathrm{w} - \mathsf{a_{mis}C_w}}{\mathsf{k_w}}. \tag{44}$$

Shared calibration data require the corresponding covariance cross terms; the design uses independent calibration so these terms vanish.

Detection: $|\mathsf{z_w}| > 3$ (U-80). Define $\mathsf{k_{w,bound}}$ by replacing the calibration factor $2\mathsf{C_w}$ with $2(\mathsf{C_w} + 20\,\mu\mathrm{rad})$ in the propagated error (U-83). Exclusion: a winding-odd contrast of 20 µrad or more is excluded when

$$|\mathfrak{d}_\mathrm{w} - \mathsf{a_{mis}C_w}| + 3\mathsf{k_{w,bound}} < \mathsf{a_{mis}}\,(20\,\mu\mathrm{rad}). \tag{45}$$

Inconclusive otherwise. Attribution: a detection is read as the projection of circulation when the same statistic, the core replaced by a vortex-free point in the same shots and the comparator recomputed for that point, returns no detection. Winding-even backgrounds cancel in both comparisons; orbital and spin terms remain in both conventional comparators.

Assumed per-shot noise is 100 µrad (U-73), winding-even scatter 30 µrad (U-74), location contribution 20 µrad (U-75), and comparator error 1 µrad (U-78). The supplied benchmarks are null rate 0.0027 for comparator values from 0 to 100 µrad in 2000000 trials each (U-79, U-82). Using comparator error 1 when its true value is 2 µrad raises the benchmark to 0.0068 in 10000000 trials (U-78, U-82). Power is 0.87 at added contrast 15 µrad and zero comparator, and 0.82 at comparator 100 µrad (U-81). The exclusion benchmarks are 0.987 with no moment at zero comparator, 0.971 at comparator 100 µrad, and

false exclusion 0.00134–0.00137 at the bound in 10000000 trials each (U-84). The vortex-free attribution-control benchmark is 0.9973 with no moment (U-85). All are design benchmarks; the comparator's error is propagated, never assigned zero. At the assumed added contrast of 20 µrad and zero comparator, the diluted prediction is 20 µrad at one figure versus ablated zero; the anticipated three-standard-error scale rounds to 10 µrad. Only one figure is licensed for that scale by the assumed noise inputs.

5.6 Numerical design model and candidate dispositions

The model uses the stated errors and common coins; two orientation readings are combined before hand assignment, and pair drift is added before the Student statistic. The permutation tails enumerate every balanced assignment. For circulation, independent Gaussian shot noise and binomial sign misreads are propagated with calibration uncertainty and the measured-group variance. The finite-trial rate uncertainty is the binomial standard error, not an instrumental uncertainty. The following simulated rates use the specified model; they test the decision rules, not an unprovided FDT amplitude.

Test	Simulated condition	Rate and trial count
T-1	Zero additional splitting	0.00265 ± 0.00016; 100000 trials
T-2	Zero additional rotation	0.00265 ± 0.00016; 100000 trials
T-3	Upper comparator endpoint	0.00138 ± 0.00001; 10000000 trials
T-4	Upper comparator endpoint	0.00137 ± 0.00001; 10000000 trials
T-5	Zero comparator, zero moment	0.00262 ± 0.00004; 2000000 trials

DC-6, SA-30 (L186), the outer-annulus emission share, is retired because no omnium-local-density to emission-profile map is supplied (O-4). DC-7, SA-79 (L492), the single-segment exciton-energy versus conjugation-length comparison, is retired because no confinement operator, boundary data or spectrum supplies that relation (O-9).

6 Cross-domain reading

The carrier identity unifies the cavity stroke with the condensate's simulated collective mode while preserving the matter-mode exciton and the source's mixed-mode name. The source's optical longitudinal order is a boundary-mode label; the braid integer identifies a matter class. No mode count, polarization share or exciton fraction supplies a particle address or a curvature ratio.

The same density mechanism receives mass, pressure, heat and stored field energy exactly once. In the isotope tests the mass input is independent of the predicted optical observable; in the twist tests the magnetic source is additional to the source cavity's tilt geometry. A uniform material response shared by the two optical paths cancels. A response differing between the core and its annulus is read as a neighbour comparison, preserving the source's spatial weights. GR containment remains exact for the same stress tensor and data; these new-source comparisons change specified inputs.

7 System-level reading (exploratory)

Scope: this section has one in-sample observable on the source's own inputs. It assigns no prospective magnetic amplitude, isotope sensitivity or confinement spectrum.

7.1 X-1: stripe position and coherent extent

The observable is the source's stripe pattern, whose defining condition is its two-component interference at fixed field identity. Define $\mathsf{l}_{\mathrm{stripe}}$ as the stripe period, $\mathcal{C}_{\mathrm{avg}}$ as the averaged density contrast, and $\mathcal{C}_{\mathrm{single}}$ as its assumed single-shot contrast. The comparator is the source's interference dictionary and random-phase

averaging, with no additional source:

$$\eta = -\tfrac{1}{2}(\mathsf{f}_1 - \mathsf{f}_2), \qquad \mathsf{f}_\mathrm{g} = -\tfrac{1}{2}(\mathsf{f}_1 + \mathsf{f}_2), \tag{46}$$

$$\mathsf{l}_\mathrm{stripe} = \frac{2\pi}{2k_0}, \qquad \mathcal{C}_\mathrm{avg} \sim \frac{\mathcal{C}_\mathrm{single}}{\sqrt{\mathsf{N}_\mathrm{sh}}}. \tag{47}$$

The phase definitions are source Eq. 6 (SD-059, L680; SD-060, L683). Using the source's $2.1\,\mu\mathrm{m}^{-1}$ (SA-40, L219) gives an estimated 3.0 µm period at two figures. The source's 16% and 500 shots give 0.7% at one figure (SA-51, L279; SA-38, L208; SD-010, L181). This is the source's random-phase contrast identity, not an independent test of phase ignorance. The estimated Fourier contrast 2.2% (SA-42, L233) is a different source quantity with an unstated Fourier convention.

Define $\mathsf{l}_\mathrm{bound}$ as the width-derived lower coherence scale. Its source relation is $\mathsf{l}_\mathrm{bound} = 2\pi/\mathsf{w}_k$. The approximate $0.5\,\mu\mathrm{m}^{-1}$ input licenses only approximately 10 µm at one figure; the source prints approximately 12 µm (SA-47, L268), a separate two-figure print. The phase histogram samples shot realizations; it supplies neither a resolved temporal phase history nor an unprinted uniformity statistic.

Guards. Every number here is an in-sample re-description. The coordinate that places the fringes is a phase, never a density-chart location. Fixed field identity persists across shots and defects. The two-component optical names carry no strand ledger. The source-input map corroborates no invariant; loss of its interference relation on those same inputs falsifies this reconstruction.

8 Convergence statement

On the source's inputs and dictionary, the limiting map fixes its effective Hamiltonian, photonic-mass simulation, Tavis–Cummings fit, fitted absorption and tail temperature, and its phase-to-stripe estimator. The twist input tends to zero; the added isotope response tends to zero; the extra vortex magnetic projection tends to zero with the conventional orbital and spin comparator retained. These are limits of new-source responses, never closed endpoints of a curvature ratio. The map recovers the source's reported, fitted, estimated and simulated values in their own classes. Its fits and reconstructions are identities, and corroborate no invariant.

I-3 contains the same curvature for the same stress and data. The I-4 dynamical containment layer recovers the Newtonian pair force at leading order in weak compactness and squared speed divided by c^2; outside that reduction the field equation remains the same solved geometry. No changed observable follows from a branch tag alone. The measured record is accepted without reservation; the additional-source and constitutive-input tests specify where the prospective observables differ.

The source says the component phases are "chosen randomly due to the spontaneous symmetry breaking" (QL-331–QL-332, L662–L667; SA-101). FDT declines that origin reading and reads the shot ensemble as ignorance of each realization's initial helical phases, with the observed pattern fixed by one deterministic settlement (I-4, 0.1a). The standard carrier account separates interaction carriers and their exchanges. FDT reads interactions as curvature plus geodesic motion of the one carrier (I-2), retaining the same measured optical response. The standard particle account assigns intrinsic masses to distinct entities. FDT reads mass as a confinement eigenvalue of a braid configuration's own support (I-5), retaining the fitted dispersive masses as optical responses. The standard background account treats clocks and rulers as metric readers. FDT reads their common adjustment as the geometry (0.1a, 0.1c). The standard account treats magnetic force as distinct from motion through a density gradient. FDT reads each pattern's gradient response from its own rest-energy clock factor (0.1c, P-5), with the gravitational universality unchanged.

The source states that the suppression of the sensitivity of the phase of the condensate to disorder with increasing fluid density occurs "not for a flow, but in the course of the condensation process" (QL-220–QL-221, L423–L424; QL-222–QL-223, L428–L429; SA-69). After its explicit superfluid qualifier, its conclusion states that the observations confirm the supersolid nature of the observed phase (QL-254–QL-256, L484–

L486; QL-385, L487). The manuscript's experimental-evidence positioning retains both statements; no measured frictionless flow, vortex circulation or magnetic signal is inserted into that source record.

9 Status ledger

Item	Status and content	Use / convergence value
O-1	Owed: the finite-core cutoff r_c, the regular core chart, or the outward phase-transfer law.	Atlas domain only.
O-2	Owed: a geometrically constructed odds for the overlap-contrast application (A-3).	Token and range only.
O-3	Owed: a canonical odds for the confinement application (A-4).	Token and range only.
O-4	Owed: the local profile $\rho_{\mathrm{loc}}(r_f)$ from the omnium constitutive law with boundary, surface and core data, reducing to the measured nuclear profile.	No emission map; annulus candidate retired.
O-5	With R_{H} denoting horizon radius, owed: multipole and tidal remainders of the closed-form pair expression, and the reading they give of the band $R_{\mathrm{H}} < r_f < R_s$ outside a rotating source's horizon; the overlap complex; how P-4's many-cone settlement signs a pair it does not join.	No supplied remainder or many-cone kernel.
O-6	Owed: the maps from a charge, a circulating charge or a colour seat to an I-1 input; derivation of the A_2 seat table from cone geometry; the gluon octet's dynamics.	No numerical twist-to-moment kernel.
O-8	Owed: the constitutive derivation of $c_{\mathrm{eff}}/n_{\mathrm{cone}}$ and its reconciliation with lensing.	Aperture assignment enters no optical number.
O-9	Owed: the confinement operator D, its domains, boundary data and spectrum; every mass ratio, including the two held-out targets.	Eigenproblem only; segment-energy candidate retired.
O-16	Owed: the kinematic reading of the share on the interior chart: the flow reading of 0.1c stops at the fold, and the velocity sphere is the support only for a pattern held on the exterior branch.	Translation share kinematic; no interior-chart reading.
Mass ratios	Held-out targets: 1836.15267343 and 4.2753×10^4 (U-05, U-06), respectively the proton/electron ratio and squared muon/electron ratio.	Neither is an output.
A-3, A-4, A-5	PROVISIONAL tokens.	Open range only; no values or trajectories.
Aperture	POSITED constitutive assignment.	Separate from exact optical metric.
T-1	Prospective existence test; extra twist source.	Zero conventional hand contrast; exclusion size 25 µeV per hand (U-16).
T-2	Prospective existence test; extra twist source.	Zero conventional hand contrast; exclusion size 100 nrad per hand (U-33).
T-3	Prospective sign test; isotope density input, declared positive sensitivity.	Comparator $[-0.02, +0.01]$ in log splitting (U-46).
T-4	Prospective sign test; isotope density input, declared positive sensitivity.	Comparator $[-0.002, +0.002]$ in index (U-61).
T-5	Prospective existence test; vortex magnetic projection.	Conventional winding-odd orbital plus spin comparator, including dilution.
Source readings	In-sample: all reproduced fits, simulations, gap/share, contrast, phase and coherence reconstructions; experimental-evidence positioning.	Identity map, no invariant corroboration.

10 Conclusions

The manuscript reads the source's stripe coherence as phase fixation, its shot-wide pattern as one settlement, its condensation and periodic order as one eigenmode snap, its RDSOC as geometry acting on the stroke's spin, and its cavity as the pattern's support. These are experimental-evidence readings of the core clauses quoted above, with the source's nouns, observables and superfluid qualifier retained. They recover the record on its own inputs and corroborate no invariant.

The prospective differences occupy new measurements: hand-odd energy and rotation from physical twist, isotope changes beyond joined conventional intervals, and a circulation-odd magnetic projection beyond the orbital and spin comparator. Independent response calibration, order randomisation, spatial reference comparisons and covariance fix their resolvable scales. No core amplitude replaces an assumed

test point. The profile and single-segment-energy candidates have no supplied observable map. FDT's true extension retains the consensus data while assigning these specified additional inputs to the prospective tests.

References

[1] M. Muszyński, P. Kokhanchik, R. Mirek et al., "Observation of a supersolid phase in a spin-orbit coupled exciton-polariton Bose-Einstein condensate," *Science Advances* **12**, eaee4875 (2026), doi:10.1126/sciadv.aee4875.

[2] *Core FDT Invariants*, locked version 6.3, clauses 0.1–0.6, I-1–I-7, P-1–P-5 and Use.