Monolayer van der Waals kagome lattice for high-temperature flat-band physics, read point by point through Fundamental Density Theory

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Target: H. Bong, C. Won, S. Lee, S. Oh *et al.*,
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Abstract

Fundamental Density Theory (FDT) reads the record of Bong *et al.* [1] point by point, in the record's own order. The source is experimental; every measurement is accepted in full, and each one a core clause reads is read as that clause's exhibit. The isolated flat band is localisation in disconnected nodal pockets of the clamp net the Pd nuclei fix (P-2, P-3); its flatness is a confinement cost the pockets fix, which the crystal momentum moves by less than the record's bounds in bulk $Rb_2Pd_3S_4$, 70 meV along $\bar{\Gamma}$–$\bar{M}$ and 180 meV near $\bar{K}$ (I-5); its interference is the cancellation of locked helical phases (I-4); its energy scales enter the density ledger of I-7; the calculated 1/3 state takes the manuscript's Laughlin reading $K = (3)$ through I-5a's fractional accounting, the strand ledger integral; the probes are one carrier (I-2); and gating is one system-wide settlement (0.1a). The convergence statement accepts every measured number in full, returns the record's kagome Coulomb estimate, per-cell counts and capacitor density on the record's own inputs, carries its remaining estimates as printed, and declines five readings. Six predictions GR and QM do not make follow where a core clause supplies a changed observable dictionary or a constitutive input: the hand-locked anomalous Hall sign of twisted bilayers, the torsion-odd stray field of a pristine ribbon and the mirror-odd Kerr rotation of twisted heterotrilayers (P-5), and the signs of the Pd, Rb and S isotope shifts at the test point of a positive, dominating density sensitivity (I-7's Discriminator fixing the input sign, the sensitivity-weighted sum the observable's), each discriminating where the consensus zero-point calculation fixes the opposite sign (I-7). Two divergence candidates are retired for want of a map (O-2, O-5). FDT is a true extension of general relativity and quantum mechanics.

1 Framework

Source, verbs and scope. The source is experimental (`source_status`: experimental) [1]: nano-ARPES of $A_2T_3X_4$ flakes down to one kagome layer, gate-dependent spectroscopy of one monolayer device, two-terminal transport of one trilayer device, and DFT, tight-binding, Hartree–Fock and exact-diagonalization calculations. Source results are written measured, observed or reported; everything else is derived, estimated, reconstructed or illustrative-assumed, and the record's calculations stay calculated and its fits fitted. Record lines are cited by their physical line number (L28, L1050), the register of the record's under-determined readings by its rows SA-01 to SA-121, and every non-source input by an assumption row, U-01 to U-15 and U-18 to U-21, with its provenance, the constants from CODATA [2]. The alkali, transition-metal and chalcogen sites of $A_2T_3X_4$ are

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written Alk, TM and Ch; where FDT, GR and QM converge FDT returns their results, and where FDT declines their assumptions it reads the same record differently.

The chain, its bridges and the strand rate (0.1, 0.1a, 0.1d). FDT has one substance, the omnium: matter, energy and spacetime are one. With E an energy, m a mass, d a distance, t a time, c the strand rate, and ε_0 and μ_0 the electric and magnetic response coefficients of the omnium, the chain is one identity read by quantum mechanics, electromagnetism and general relativity:

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

so c^2 is a medium property. The four terms adjust together, and "every step is a system-wide settlement" (0.1a). The bridges are constants of the medium and are displayed: for a mode q with rest energy E_q, mass m_q, angular frequency ω_q, T_q the time the pattern keeps and ℓ_q the length its thread runs in that time (the Compton length, never a support R_{box}), with h Planck's constant, $\hbar = h/2\pi$, lengths in metres (m) and times in seconds (s),

$$\begin{aligned} &E_q = m_q c^2 = \hbar\omega_q, \qquad T_q = 2\pi/\omega_q = h/E_q, \\ &\ell_q = cT_q = h/(m_q c), \qquad d/t = c = 299\,792\,458 \text{ m s}^{-1} \text{ exactly.} \end{aligned} \tag{2}$$

"A pattern quantised in energy is quantised in mass, in the time it keeps and in the length it runs, by the identical stroke." No variable of the chain vanishes, and with the force ceiling the floor is $d_{\min} = 2\ell_{\text{P}}$, $t_{\min} = 2t_{\text{P}}$ (ℓ_{P} and t_{P} the Planck length and time): an infimum approached by the least closed pattern and occupied by none. The constant c is the strand rate of the omnium, derived (0.1d): the two responses give $c^2 = 1/(\varepsilon_0\mu_0)$; a closed pattern's strand runs at c on a helix, $v^2 + u^2 = c^2$ with v its translation and u its circulation, and its inertia E/c^2 carries the stress of its closure (von Laue). The open stroke runs straight at c and keeps no time; its grades turn on a helix of radius $\bar{\lambda} = \hbar c/E = c/\omega = \lambda/2\pi$, with ω its angular frequency and λ its wavelength, standing at $\pi/4$ at every frequency (I-2). "The core names no objective for the optimisation" (0.1a), and this analysis names none.

I-1: one law at every input pair. With F the force between two bodies, G Newton's constant, $F_{\max} = c^4/4G \approx 3.03 \times 10^{43}$ N the force ceiling (0.2) and α_1, α_2 (each α_i) the two bodies' inputs,

$$F = \frac{c^4}{4G}\,\alpha_1\alpha_2, \qquad 0 < \alpha_i < 1 \;\text{ so }\; F < F_{\max}, \tag{3}$$

always, at all scales, two bodies. On its declared pair domain — exterior inputs $\alpha_i(d) = R_{s,i}/d$ on nonoverlapping spherical supports at monopole order, $R_{\text{b},i} \geq R_{s,i}$ and $d \geq R_{\text{b},1} + R_{\text{b},2}$, with $R_s = 2G\mathcal{M}/c^2 = \mathcal{M}c^2/(2F_{\max})$ the Schwarzschild radius of a body's total gravitating energy $\mathcal{M}$ — the law reads $F = G\mathcal{M}_1\mathcal{M}_2/d^2$ exactly. The interval ladder is kept: $0 < \alpha < 1$ is universal, $F < F_{\max}$ holds wherever the inputs occupy that interval, and $F \leq F_{\max}/4$ is the only pair-domain statement, its equality needing equal saturated supports at contact. The record's "Weak … vdW … bonds" (Fig. 1c, L65–L68) are I-1's pair work. For two Pd nuclei across the van der Waals gap, declared spherical supports on I-1's domain at the record's interlayer spacing of 0.7 nm (L708, L1517), each exterior input, the A-1 compactness of the chart inventory below, is $\alpha_{\text{ext}} = \mathcal{M}c^2/(2F_{\max}d) \approx 4 \times 10^{-43}$, with $\mathcal{M}$ the mass of the ^{106}Pd atom, 105.903 u (U-08 [4], with u from U-05; the electrons' share changes no printed figure), and the pair returns $F \approx 4 \times 10^{-42}$ N, one figure, the spacing's. "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 ≠ force).” No kernel, no Coulomb scale from I-1 and no map from a charge to an I-1 input is written here (O-6); the record's Coulomb scale (L731) is carried as the record's number.

I-2: one carrier, the record's probes. “photon = graviton = gluon = phonon = magnon ... the same spin-1 excitation of the density field, at different density / geometry regimes.” “There are no independent force carriers. ‘Mediation’ is a coordinate artifact; interactions are curvature plus geodesic motion.” The record's probes are this one carrier at different regimes. The 98-eV ARPES photons (L1250) have $\bar{\lambda} = \hbar c/E = 2.0$ nm (U-02). The 514-nm Raman laser (L1209) has $E = hc/\lambda = 2.41$ eV and $\bar{\lambda} = \lambda/2\pi = 81.8$ nm (U-02). The S vibrations “around 280” and 355 cm^{-1} (L1426–L1427) are the same carrier in the phonon regime, and a magnon is the stroke through a helical density gradient, which P-5 reads as a magnetic field B. The regime names carry the A-5 token α_{mode}, which ranks nothing; the record's “carrier doping was mediated through the top graphene layer” (L1247) means that the graphene supplied the gate charge.

I-3: the three faces and the cone orientation. With r_f the declared field radius, from r_c, the finite-core cutoff, whose value is not written here (O-1), to ∞, R_s the Schwarzschild radius of the source's total gravitating energy, $\sigma = \pm 1$ the branch tag and X_{ext} the gap odds, the density coordinate is the branch-tagged curvature ratio α_σ, with exterior and interior branches α_{ext} and α_{int},

$$\begin{aligned} \alpha_\sigma = (R_s/r_f)^\sigma : \qquad & \alpha_{\mathrm{ext}} = R_s/r_f \;\; (\sigma = +1,\; R_s < r_f < \infty), \\ & \alpha_{\mathrm{int}} = r_f/R_s \;\; (\sigma = -1,\; r_c \le r_f < R_s), \\ X_{\mathrm{ext}} = R_s/(r_f - R_s), \qquad & \alpha_{\mathrm{ext}} = X_{\mathrm{ext}}/(1 + X_{\mathrm{ext}}), \end{aligned} \tag{4}$$

The ratio is built from two lengths fixed before any observation is consulted, and it carries no fitted coefficient. “Odds” is this algebra and carries no probabilistic reading; both branches approach 1^- at the fold $r_f = R_s$, and actual density orders by $q_\sigma = \alpha_\sigma^{3\sigma}$, never by the raw ratio. The exact optical-metric face, with ℓ_{opt} the optical length and Ξ the solid angle (the core's $\mathrm{d}\Omega^2$, renamed because Ω is I-5's confinement domain), is

$$\mathrm{d}\ell_{\mathrm{opt}}^2 = \frac{\mathrm{d}r_f^2}{(1 - \alpha_{\mathrm{ext}})^2} + \frac{r_f^2\,\mathrm{d}\Xi^2}{1 - \alpha_{\mathrm{ext}}}, \tag{5}$$

and generalised Snell's law is the Fermat jump law of this metric with the exact index. The field equation is unchanged, with $G_{\mu\nu}$ the Einstein tensor, $T_{\mu\nu}$ the stress tensor and κ the Einstein coupling:

$$G_{\mu\nu} = \kappa T_{\mu\nu}, \qquad \kappa = 8\pi G/c^4, \qquad \kappa F_{\max} = 2\pi. \tag{6}$$

The ratio is downstream of the solution, and for the same stress tensor and data FDT and GR return the same curvature. Cone orientation: “A band-structure cone drawn with a zero-energy vertex at its geometric tip must, on translation to a density cone, place high density and high energy at that tip.”

I-4: the quantum face and the cylindrical lift. “QM is helical geodesics on truncated density cones. The wavefunction $\psi = A\,e^{i\phi}$ 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.” Here A is the helix's projected radius and ϕ its phase. Complex mode equations are the planar projection of helical transport: in cylindrical

coordinates the helix phase is $\phi_h(t) = \phi_0 - \omega t$, and in Clifford form the imaginary unit is the bivector $\mathbf{B} = \mathbf{e}_1\mathbf{e}_2$ of two orthonormal vectors $\mathbf{e}_1$, $\mathbf{e}_2$, with $\mathbf{B}^2 = -1$:

$$\psi = A\, e^{i\phi} \;\longmapsto\; A\, e^{\mathbf{B}\phi_h}, \qquad \phi_h(t) = \phi_0 - \omega t. \tag{7}$$

The rotor $e^{\mathbf{B}\phi_h}$ is the single-angle phase rotor, distinct from a half-angle spinor rotor; its exponent is dimensionless, no density token enters a multivector slot, and no strand count sits on a mode.

I-5: the confinement eigenproblem. For a pattern confined to a domain Ω with boundary data $\mathcal{B}$, braid configuration n, orientation χ and position ζ on the inside/outside chart (the core's B and t, renamed because B is the twist's magnetic field and t a time), the cost of mode q, with eigenvector u_q of the confinement operator D, is its mass:

$$D(\Omega, \mathcal{B}; n, \chi, \zeta) \cdot u_q = \omega_q\, u_q, \qquad m_q c^2 = \hbar\omega_q. \tag{8}$$

No form of the operator D, its domains, boundary data or spectrum is written here (O-9), and no mass formula, anchor radius, absolute address for any named particle or generation identity enters. "There are no intrinsic particle masses or properties." The record's band electrons are $n = 3$ closures, the class I-5 names for the electron and the proton; a band is a family of their modes q in one confinement, the crystal's support, and its flatness is read through the cost $m_q c^2 = \hbar\omega_q$ of each mode, never through an effective-mass formula.

I-6: the bounded map. Every use of the bounded map names its application (0.4); here it is used on A-1 only. With α_0 the value before an update and $x \geq 0$ an odds-enhancing input,

$$\alpha(x) = \frac{\alpha_0(1+x)}{1+\alpha_0 x}, \qquad 0 < \alpha < 1, \tag{9}$$

so linearity lives in the odds, $X = X_0(1+x)$ with $X_0 = \alpha_0/(1-\alpha_0)$, and a finite excursion is $\delta\alpha = \alpha_0(1-\alpha_0)x/(1+\alpha_0 x)$, never a bare linear step. A fixed-geometry isotope step multiplies $\mathcal{M}$, hence R_s, by $1+\Delta_{\mathcal{M}}$ at fixed r_f (I-3 chart discipline 5), with $\Delta_{\mathcal{M}} = \Delta\mathcal{M}/\mathcal{M}$ the finite fractional isotope change; on A-1 it is the odds-enhancing input $x = \Delta_{\mathcal{M}}/[1-\alpha_0(1+\Delta_{\mathcal{M}})]$, for which the map returns $\alpha_{\text{ext}} = \alpha_0(1+\Delta_{\mathcal{M}})$ exactly, A-1 being linear in $\mathcal{M}$ at fixed r_f wherever $\alpha_0(1+\Delta_{\mathcal{M}})$ stays below one, so r_f stays on the exterior branch and $\Delta \ln \alpha_{\text{ext}} = \Delta \ln \mathcal{M}$. At the exterior-branch test point $\alpha_0 = 0.3$, a point inside the open interval, and $\Delta_{\mathcal{M}} = 0.2$ (U-20), the input is $x = 0.3125$ and the map returns 0.36.

I-7: density equivalence. With M the rest mass, P the pressure, V the volume, T the temperature and σ_{SB} the flux constant,

$$\begin{aligned} &\mathcal{M} = M + E/c^2 + PV/c^2 + aT^4V/c^2 + \ldots, \\ &a = 4\sigma_{\text{SB}}/c, \end{aligned} \tag{10}$$

with $a = 7.566 \times 10^{-16}\ \text{J m}^{-3}\,\text{K}^{-4}$ (U-06), every channel entering once (0.5), and "MASS ≡ ENERGY ≡ TEMPERATURE ≡ PRESSURE → DENSITY": "Mass, energy, temperature and pressure all enter the same R_s; isotope, thermal and pressure shifts are one mechanism." For a flake of the record the channels are its nuclei in M and its closures in M at the cost $m_q c^2 = \hbar\omega_q$ of each occupied mode, their band energies entering there and nowhere else; in E/c^2 what those mode costs leave out, the exchange and interaction compression the record writes as its Coulomb and

Hubbard scales and the gate field's energy; the stack's load in PV/c^2; and the radiation at the bath temperature in aT^4V/c^2; each enters once, and gravitational binding is read from the geometry. "Pressure-driven lattice compression and exchange / interaction compression are I-7 density channels"; the record's carrier density $\mathfrak{n}$ is a count per area, not this density, and carries no ratio and no ordering. The Discriminator: "For purely density-coupled equilibrium observables, a heavier isotope → larger R_s → higher α → larger response — opposite in sign to conventional reduced-mass scaling."

The anchors P-2 to P-5 and the helical window. P-2: "the loci where the transverse density gradient vanishes ... are the nodal lines and surfaces — the density geodesics — and excitations migrate to and lock into them as sand collects on the nodes of a vibrating plate"; "eigenstates, phonon modes and orbitals are nodal patterns of the driven density field; ... localisation is trapping in disconnected nodal pockets"; "mode geometry is set by the boundary conditions (the clamps, P-3), not by the medium." P-3: "Atomic nuclei are the saturated density cores of a material's Chladni volume: fixed pinning sites." P-4: "every density cone carries a flow direction"; "same flow direction → repulsion; opposite flow direction → attraction", the sign "of every pair a settlement joins"; no map from a site's moment to its cone's flow direction is written here. P-5: "A magnetic field is a macroscopic helical density gradient of the omnium: the bivector grade of the density field coherently aligned along an axis; vortex lines are bivector topological defects. 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." No such form is derived here, so every twist block below predicts an existence and a sign that one hand carries, never a magnitude: a first session fixes the unassigned sign by the direction of its rejection, a first session that does not reject fixing none and leaving the block undecided, and a second, independent session decides by the same statistic one-sided at the $\mathfrak{z} = 3$ rate of U-11 in each direction, $\mathfrak{z}$ the standard-normal deviate, a rejection in the direction the first fixed confirming the block and one in the opposite direction contradicting it. The helical window of 0.1c, with $\mathfrak{m}$ its clock factor: "a pattern whose rest energy depends on where it sits in a twist — the helical density gradient of P-5 — takes that energy as its clock factor. With m its held moments, B the twist's magnetic field where they sit (0.1d, P-5), E_{ind} the energy of the moments the twist induces in it, the work of inducing them included, E_0 its rest energy outside every twist, a constant (0.1d), $\mathfrak{A}$ its action and z the coordinate along the twist's gradient:"

$$E = E_0 + E_{\mathrm{ind}} - \sum \mathsf{m} \cdot B, \qquad \mathfrak{m} = E/E_0, \qquad \mathcal{M}\,\frac{\mathrm{d}^2 z}{\mathrm{d}t^2} = -\partial_z E, \tag{11}$$

the last in the slow limit, each m held at its settled value, with $\mathcal{M} = E/c^2$; and "The gradient of E gives the push and its second derivatives the spring; a uniform level added to E changes $\mathcal{M}$ and leaves the push unchanged, and a uniform twist, a uniform level of $\mathfrak{m}$, turns a held moment and pushes nothing." The manuscript reads the record's Kane–Mele spin–orbit term (L47, L1576) as the $-\sum \mathsf{m} \cdot B$ term of this window where the pattern sits, a reading of its own; the record's spin–orbit gaps are DFT values (SA-14, SA-34), and its ferromagnet (L1086–L1090) is a mean-field output (SA-64).

Notation guard. The record's symbols that collide with core tokens are renamed on every surface, as the table below lists.

record symbol (locus)	collides with	written here
A, T, X as the three sites (L29, L160)	A-n applications; temperature; odds	Alk, TM, Ch; the family as the label $A_2T_3X_4$
n, the carrier density (L577, L926, L1287)	the strand count n (I-5)	$\mathfrak{n}$
a, the localization length (L729) and the cell (L925, L933)	$a = 4\sigma_{\mathrm{SB}}/c$	$\mathfrak{a}_{\mathrm{loc}}$; $\mathfrak{a}_{\mathrm{cell}}$ (SA-29)
U, the Coulomb estimate (L731) and the Hubbard scale (L1083)	the pair energy (I-1); the four-velocity (0.1c)	$\mathfrak{U}_{\mathrm{C}}$; $\mathfrak{U}_{\mathrm{H}}$ (SA-76)
W, the widths (L728, L730, L773–L774, L1081)	the gate's W prefix	four objects, never merged: $\mathcal{W}_{\Gamma\mathrm{M}}$, $\mathcal{W}_{\Gamma\mathrm{K}}$ (bulk bounds), $\mathcal{W}_{\mathrm{flat}}$, $\mathcal{W}_{\mathrm{2D}}$
Berry curvature (L1036, L1097)	the confinement domain Ω	$\mathcal{F}_{\boldsymbol{k}}$
quantum metric (L1036, L1532)	the metric $g_{\mu\nu}$	$\mathfrak{g}_{ij}$
C: Chern numbers (L1090, L1321); capacitances (L1288)	each other	$\mathcal{C}$, $\mathcal{C}_{\mathrm{mb}}$; C_{BG}, C_{TG}
V: gate voltages (L1051, L1059); the potential (L1307)	the volume V (0.5)	$\mathcal{V}_{\mathrm{G}}$, $\mathcal{V}_{\mathrm{TG}}$, $\mathcal{V}_{\mathrm{BG}}$; $\tilde{\mathfrak{U}}(k_{\mathrm{tr}})$
q, the momentum (L1307)	the density order q_σ; the mode q	k_{tr}
d, the screening length (L1307); the dielectric thicknesses (L1292)	the chain's d	ℓ_{scr}; $\mathfrak{d}_{\mathrm{SiO_2}}$, $\mathfrak{d}_{\mathrm{hBN}}$

record symbol, continued	collides with	written here
N, the exact-diagonalization size (L1529)	a conserved count (0.1c)	$\mathcal{N}_{\mathrm{ED}}$ (SA-116)
twist angles (L791, L1536)	the deflection θ; the helix phase ϕ	Θ
R, the resistance (Fig. 4)	R_s, R_{b}	$\mathcal{R}$, in Ω
K, M, Γ zone points; the momentum sector (L1317)	$K_\cap$; M; Γ	upright K, M, Γ; $\boldsymbol{k}_{\mathrm{tot}}$
a_{HF}, the Hartree–Fock fraction (L1312)	$a = 4\sigma_{\mathrm{SB}}/c$	"the HF fraction", no symbol
T in kelvin (Fig. 4)	the period T_q (0.1a)	T the temperature; T_q only the period
λ, the Raman wavelength (L1209)	the stroke radius $\bar{\lambda}$ (I-2)	"the 514-nm laser"
E_C, the Landau-level scale (L1536)	—	E_{LL}, with ℓ_{mag}
the FQAH gap (L1033)	the finite isotope change Δ (I-7)	E_{gap}
the zone area (L1097, L1531)	the A-n applications	$\mathcal{A}_{\mathrm{BZ}}$
the stripe labels (L1034)	the pressure P; the P-anchors	"the period-2 and period-3 stripe phases"
the element S (formulas; T-5's isotopes)	the sensitivities S_i (I-7 discipline 2)	upright S; each sensitivity carries a channel index, S_{dens}, S_{geo}, S_{ZP} and S_{clamp} for the density, lattice-constant, zero-point and nuclear-size channels of T-3
B in the record's subscripts only	I-5's boundary data; the lift's unit; 0.1d's bold field	italic B the twist's field; $\mathcal{B}$ I-5's boundary data; bold $\mathbf{B}$ the lift's unit only
design counts and angles of T-1 to T-5 and T-7	n, N, M, L, τ, θ, s, Δ	numerals; the lock count $\mathcal{L}$ of T-1, the clamp angle Θ_{c} of T-2, the polar Kerr rotation Φ_{Kerr} of T-7 and the flat-band top above the Dirac point E_{FD} of T-3

Chart inventory. The inventory is declared once, here. A-1, compactness, with geometric warrant: the atlas α_σ of Eq. (4) with its field-point, configuration and source evaluations. For one Pd nucleus the exterior compactness at $R_{\mathrm{room}} = 4.5$ fm (U-09), the rms charge radius of ^{106}Pd [5] — a skin-weighted second moment, its probe weight the charge, taken as the support size and declared not interior, so that no point value of the profile is read off it — is $\alpha_{\mathrm{ext}} = 5.8 \times 10^{-38}$, and at the gap of the I-1 pair it is the 4×10^{-43} above. For the declared flake of U-10, a 20 µm square of monolayer $Cs_2Pd_3S_4$, one formula unit per hexagonal cell of side 1 nm (U-05, U-07), the exterior compactness at $r_f = 1$ mm is $\alpha_{\mathrm{ext}} = 8 \times 10^{-40}$. These are laboratory-small and correct readings (0.1c), all far below A-1's exterior seam at 1/2 ($r_f = 2R_s$, $\sigma = +1$), on the general-relativistic reading of A-1. Each nucleus read as a clamp — the Pd nucleus, the Ch and Alk nuclei and the nuclei of the encapsulating layers — carries two charts, both declared: the exterior atlas at its

gravitational R_s, and its interior chart read with its skin at the fold and $R_{\rm room}$ taken from data, a number read here for Pd alone; no transfer map between them is displayed and none is used. On the interior chart the density is densest at the skin and the centre is the dilute region; no numerical interior profile is written (O-4). The saturation diagnostic $\alpha_{\rm core} \to 1^-$ (P-3, schematic only) is the skin value of that interior chart, and it is not the exterior compactness of the same nucleus, which is $\ll 1$. A-2, with geometric warrant, the computational chart $\beta_\sigma = \alpha_\sigma/(1+\alpha_\sigma)$: computational only, never a force, optical or density slot. A-3, overlap and contrast, without geometric warrant, the token $\alpha_{\rm ovl}$ on a declared local density contrast $X_{\rm ovl}$: a token with its range and nothing else (O-2). A-4, confinement, without geometric warrant, the token $\alpha_{\rm conf}$ on I-5's cone-position axis: a token with its range and nothing else (O-3). A-5, mode manifestation, without geometric warrant, the token $\alpha_{\rm mode}$ naming I-2's regimes (photon, phonon, magnon): it ranks nothing and spaces nothing. No ratio of these charts is assigned to a band, a pocket, a filling or a material, and no filling is an α of any application.

2 System chart table

The patterns of the record, their roles, the chart and token each carries, and the clause that reads it:

pattern	role in the record	chart and token	clause
Pd nucleus at a TM site	a site of the kagome lattice formed by the TM atoms (L580–L581)	A-1: $\alpha_{\rm ext} = 5.8 \times 10^{-38}$ at $R_{\rm room}$; interior chart, skin at the fold; $\alpha_{\rm core} \to 1^-$ schematic	P-3; I-1 input at the gap
Ch nuclei (S, Se)	set the hopping ratio in the record's reading (L727)	A-1, laboratory-small; interior chart, skin at the fold, $R_{\rm room}$ from data, the rms charge radius of each Ch nucleus [5], a skin-weighted second moment, its probe weight the charge, taken as the support size and declared not interior, with no number read on it here; $\alpha_{\rm core} \to 1^-$ schematic, as for Pd; no ratio for a hopping	P-3 clamps
Alk nuclei and the nuclei of the encapsulating layers	the alkali site, which "plays a marginal role" in the record's reading (L593), and the graphene and graphite of the stacks (L781–L782)	A-1, laboratory-small; interior chart, skin at the fold, $R_{\rm room}$ from data, with no number read on it here; $\alpha_{\rm core} \to 1^-$ schematic, as for Pd	P-3 clamps
monolayer flake (U-10)	the 2D system	A-1: $\alpha_{\rm ext} = 8 \times 10^{-40}$ at 1 mm	I-7 ledger, Eq. (10)
band electrons of the TM-d_{xy} manifold	flat band and Dirac bands (L766–L767)	$n = 3$ closures; A-4 token $\alpha_{\rm conf}$, range only	I-5, Eq. (8)
ARPES photons, Raman photons, S vibrations	probes; the S vibrations measured	$\bar{\lambda} = 2.0$ nm and 81.8 nm for the photons; the A-5 token $\alpha_{\rm mode}$ names the regimes	I-2
gated heterostructure	tuning of the flat band (L1050)	no ratio; one settlement	0.1a
overlap of two density distributions	the calculated correlated phases (L1031)	A-3 token $\alpha_{\rm ovl}$, range only	I-1a

3 Observation map

The record's claims are taken in the record's own order — the abstract and the introduction, the bulk family (Fig. 2), the two-dimensional devices (Figs. 1 and 3), gating and transport (Fig. 4), and the theory (Table 1 and Fig. 5) — one row per claim, with the claim in the record's words and locus, its verb class from the ledger, the FDT reading and the clause that carries it. Each cluster closes with its corroboration: the clause named, the precision stated, the falsifier given. A step that returns the record's own value from the record's own inputs is the identity map of Use item 2 and corroborates no clause.

3.1 Cluster 1: the abstract and the introduction

record claim (locus; register row)	verb	FDT reading	clause
"Kagome lattice materials host a variety of intriguing quantum phenomena" "arising from the intrinsic interplay of topology, electron correlations" "and geometric frustration" (L23–L25; SA-01)	quoted	Accepted; "intrinsic" qualifies the interplay, never a particle property; geometric frustration is the record's lattice property, accepted as stated	—
"Here we demonstrate ideal two-dimensional monolayer kagome lattices" (L28; SA-02)	quoted	One TM net clamped within one layer: P-3's pinning sites hold the nodal architecture at every measured thickness	P-3
nano-ARPES "directly characterizes the electronic structure" (L31), an isolated kagome-derived "flat band just below the Fermi level" (L33; SA-02)	measured	Localisation in disconnected nodal pockets of the TM net; each band electron an $n = 3$ closure whose cost the pockets fix, the crystal momentum moving it by less than the bulk bounds of Cluster 2	P-2, I-5
the flat band "can be further tuned to the Fermi level" (L34; SA-02, SA-72)	quoted	One settlement of the gated stack moves the cost of every mode at once	0.1a
"more than 220-fold higher flat-band electron density" (L37; SA-03)	quoted	The abstract's figure; the main text's estimates give 10^2 at one figure (Cluster 3)	—

record claim, continued	verb	FDT reading	clause
"Dirac fermions" (L45) and "long-range entanglement" (L47; SA-04, SA-05)	quoted	Declined readings, written in the convergence statement: braid configurations of one excitation; a shared bivector grade, deterministic	I-5, I-4
"Laughlin-type fractional ground states" (L161) and twisted kagome bilayers that "have been theoretically proposed" (L167; SA-08, SA-10)	quoted	The introduction's programme: the Laughlin-type state is calculated in Fig. 5 (Cluster 5) and measured nowhere in the record, and no twisted kagome bilayer is made in it; the twist outlook seeds T-1	P-5
"more than two orders of magnitude higher carrier density", $\mathfrak{n} \approx 1.0$ nm^{-2} against 0.01 nm^{-2} (L577–L578; SA-15, SA-16)	estimated	Per-cell counts, accepted as the record's estimates; their ratio is 10^2 at one figure, the identity map	—
the many-body calculations that "uncover fractional quantum phases in monolayer $A_2T_3X_4$ at" temperatures "an order of magnitude higher than currently achievable in moiré" systems (L582–L583; SA-18)	calculated	The record's prospect from calculated gaps: the exact diagonalization computes no temperature, and no temperature is attached to a gap here	—
the kagome lattice formed by the TM atoms (L580–L581), the crystal field "effectively isolating a single" d_{xy} orbital (L584; SA-17, SA-109)	premise	The clamp net: the TM nuclei are P-3's pinning sites, and their geometry, not the medium, sets the nodal pockets	P-2, P-3
"a semiconductor with a bandgap in the visible light range" (L588); the colours "indicating that the electronic structure and optical bandgap are widely" "tunable by varying the transition metal or chalcogen site, whereas the" "alkali metal site plays a marginal role" (L591–L593; SA-19, SA-20, SA-53)	quoted	The Ch nuclei are clamps beside the TM net; the Alk mass enters $\mathcal{M}$ once; T-4 and T-5 take the two sites up	P-3, I-7

Corroboration. P-2 and P-3 read the cluster's measurements as exhibits, on the record's own data

and at its precision: an isolated flat band below the Fermi level whose dispersion in bulk $Rb_2Pd_3S_4$ is bounded at 70 meV along $\bar{\Gamma}$–$\bar{M}$ and 180 meV near $\bar{K}$ (L773–L774) at an energy resolution better than 40 meV (L1246). Falsifier: a change of the flat band's dispersion resolved at the $\mathfrak{z} = 3$ rate against the errors of its measurement, with covariance (the record prints an energy resolution only for the bulk flakes, better than 40 meV, L1246, and none for the encapsulated stacks, L1223–L1252 and L1258–L1267), with every clamp of the stack held — the TM net, the Ch and Alk nuclei and the nuclei of the encapsulating layers, all of them P-3's pinning sites — would put the mode geometry outside the clamps, against P-2's "set by the boundary conditions (the clamps, P-3), not by the medium".

3.2 Cluster 2: the bulk family (Fig. 2)

record claim (locus; register row)	verb	FDT reading	clause
bulk-like flakes, "a thick enough flake (>30 nm)" (L565; SA-12)	premise	Accepted; the thickness threshold as the bulk limit is the record's premise	—
DFT: "The topmost band (red) realizes a quasiflat band" and "two lower bands (black) form a Dirac point" (L766–L767; SA-40)	calculated	One closure family in one confinement, distinct modes q of one eigenproblem: the flat band's localised modes and the Dirac bands' extended modes	I-5
the quasiflat band in $Rb_2Pd_3S_4$ "remains almost completely dispersionless along" $\bar{\Gamma}$–$\bar{M}$, $\mathcal{W}_{\Gamma M} < 70$ meV, with "only a small dispersion near" $\bar{K}$, $\mathcal{W}_{\Gamma K} < 180$ meV (L772–L774; SA-42)	measured (bounds)	Along $\bar{\Gamma}$–$\bar{M}$ a mode whose cost the probe's crystal momentum moves by less than the record's bound, the band "almost completely dispersionless" there (L772), the pocket, not the momentum, fixing it; near $\bar{K}$ the momentum moves it by less than the bound, the small dispersion the record measures; both are bounds, the first below twice the 40-meV resolution (L1246)	I-5, P-2
the flat band "remains" "dispersionless along the out-of-plane momentum direction" (L776–L777; SA-43), photons scanned "from 60 to 200 eV" (L1248)	measured	Clamps in plane: the TM net bounds the pockets within one layer, and the van der Waals gap adds no node to them	P-2, P-3
the overall d_{xy} band width larger for the 4d-Pd than for the 3d-Ni compounds (L722; SA-25, SA-46)	measured	Accepted; the Ni-to-Pd step also changes Cs to Rb, so no site effect is read off the series	—

record claim, continued	verb	FDT reading	clause
the quasiflat band significantly flatter for S than for Se (L728–L729); the Ch atoms, "which set the ratio between nearest-neighbour and" longer-range hoppings (L727; SA-27)	reported; quoted	The Ch nuclei are clamps of the same net; the hopping ratio is the record's tight-binding reading, and no map from a hopping integral to a core quantity is written	P-3
"the flattest band width of" $\mathcal{W}_{\text{flat}} \approx 180$ meV (L730; SA-30)	measured; approximate	Fig. 2j's width, "extracted from the" experimental ARPES spectra (L571–L572), the figure the $\bar{K}$ bound also prints (L774), $\mathcal{W}_{\text{flat}}$: a third width object, never merged with the two bounds	—
SOC gaps "obtained from DFT" (L572); the correlation degree "estimated from the renormalization factor" (L734); the HF fraction set "by comparing to experimental data" (L1314) and the factor applied "to match experimental dispersion" (L1317; SA-14, SA-34, SA-36, SA-106)	calculated; fitted	Calculated and fitted, in-sample: a fitted experiment-to-DFT ratio, never an effective-mass formula or an address	I-5
"these surveys demonstrate that not only the kagome dispersion but" also the SOC and correlation strengths are engineerable (L737–L740; SA-36)	quoted	The record's evaluation; its SOC strengths are calculated, read as the $-\sum \mathsf{m} \cdot B$ term of the helical window	P-5

Corroboration. I-5 and P-2 read the bounds as exhibits, on the record's own data and at the precision of the bounds: within 70 meV along $\bar{\Gamma}$–$\bar{M}$, under twice the 40-meV resolution, the flat

band's cost is unmoved by in-plane crystal momentum, near $\bar{\mathrm{K}}$ the momentum moves it by less than 180 meV, the small dispersion the record measures, and within the resolution it is unmoved by out-of-plane momentum. The record's agreement between ARPES and DFT is in-sample (SA-106, SA-120) and corroborates nothing. Falsifier: an out-of-plane dispersion of the flat band resolved at the $\mathfrak{z} = 3$ rate against the errors of its measurement, with covariance, in bulk-like flakes of unchanged in-plane net.

3.3 Cluster 3: the two-dimensional devices (Figs. 1 and 3)

record claim (locus; register row)	verb	FDT reading	clause
the "thickness of ∼0.7 nm" of one layer (L708), lateral "dimensions of 10–30 µm" (L712), stability "for at least 60 days" (L711) against "after 10 days" in the caption (L1422; SA-23, SA-24)	measured; quoted	Accepted; the duration is carried as the caption's 10 days, the main text's 60 days quoted	—
graphene/flake/graphite stacks, the graphite a "support that enhances the crystallinity of the ultrathin kagome flake" (L754; SA-39)	premise	The record's premise; graphene, flake and graphite are parts of one settling system	0.1a
only the covered flake "exhibits a sharp doublet spectrum" (L770), which "directly demonstrates the high stability" (L773; SA-41)	measured; quoted	Accepted	—
graphene and graphite Dirac points, "which correspond to Dirac electrons from the top" graphene (L781; SA-04, SA-44)	quoted	The graphene's Dirac electrons are $n = 3$ closures in the modes of another net; the reading of "Dirac electrons" as distinct particles is declined	I-5
twist angles "28.9°" and "20.2°" (L791) for one "specific heterotrilayer" (L792), the sense of each interface unstated (SA-47)	measured	The manuscript reads a stack whose interfaces turn in one sense as a helical geometry, P-5's physical twist; the record states no sense for this stack's interfaces, and T-7 takes the reading up	P-5

record claim, continued	verb	FDT reading	clause
data compiled "from both Rb2Pd3S4 (bulk and eight layers) and Cs2Pd3S4" (L922); "sharp non-dispersive flat bands" and Dirac bands "clearly resolved" to one layer (L924–L925); "minimal" "dependence on layer thickness" (L926–L927; SA-53, SA-55)	reported	The clamp net, not the stacking, fixes the pockets from bulk to one layer; the series changes compound between eight and four layers, so no thickness effect is read apart from an Alk effect	P-2, P-3
monolayer bands "lying within only 420 meV" of the Fermi level (L932), a shift that "signifies strong charge transfer from" the monolayer to "the adjacent graphene/graphite layers" (L933–L934), suggesting "the sensitivity of the Fermi level in 2D $A_2T_3X_4$ to local" environments (L935; SA-58)	reported; quoted	The shift is measured, the transferred charge is the record's reading: the heterostructure settles as one system	0.1a
moiré: "one flat-band electron per large" supercell, $\mathfrak{a}_{\mathrm{cell}} \approx 10$ nm, $\mathfrak{n} \approx 0.01$ nm^{-2} (L924–L926); kagome: one "electron per unit cell", $\mathfrak{a}_{\mathrm{cell}} \approx 1$ nm, $\mathfrak{n} \approx 1$ nm^{-2} (L932–L935; SA-54, SA-56, SA-59, SA-60)	estimated	Identity map: $\mathfrak{n} = 1/\mathfrak{a}_{\mathrm{cell}}^2$ returns both, ratio 10^2; Table 1's lengths (L729) give $(52/6.2)^2 = 70$; a per-cell count is the band's density over its own support, never an electron inside a cell	0.1b
"destructive interference of electron" hopping "in a frustrated geometry" (L930–L931; SA-57)	quoted	Declined reading: the cancellation of projected helical phases that the clamp net locks around each hexagon, deterministic	I-4, P-2

Corroboration. P-2 and P-3 read the series as an exhibit, on the record's own data and at its qualitative precision across five devices of two compounds: the flat band and the Dirac bands persist from bulk $Rb_2Pd_3S_4$ to monolayer $Cs_2Pd_3S_4$ with minimal thickness dependence (L922–L927). 0.1a reads the measured position of the monolayer's bands within 420 meV of the Fermi

level (L932) as an exhibit of one settlement, on the record's own data; that the environment moved them is the record's charge-transfer reading (L933–L935; SA-58). Falsifier: a monolayer whose flat band, with every clamp of the stack held — its TM net, its Ch and Alk nuclei and the nuclei of its encapsulating layers, all of them P-3's pinning sites — lost its isolation or acquired a dispersion resolved at the $\mathfrak{z} = 3$ rate against the errors of its measurement, with covariance.

3.4 Cluster 4: gating and transport (Fig. 4)

record claim (locus; register row)	verb	FDT reading	clause
a single-gated device with "an exposed" top surface (L1048) beside the caption's "cover graphene" (L903; SA-70, SA-49)	reported	Accepted with both descriptions	—
the flat band tuned "over a 390-meV range" with the gate "from −7.5 to 11 V" (L1050–L1051; SA-70), at room temperature (L1248; SA-89)	measured	One settlement of the gated stack moves the flat band's cost, its $n = 3$ closures keeping their class (I-5); the gate field's energy enters $\mathcal{M}$ once	0.1a, I-7
the flat-band energy "saturated beyond" $\mathcal{V}_{\mathrm{G}} < -2.5$ V, "suggesting" that its top reached the Fermi level (L1054–L1055; SA-72); the illuminated hBN's "finite conductivity" (L1251), together with the absence of a top gate (L1258), limits the gate to "∼30%" (L1260; SA-93) of what a standard transport device achieves	measured; quoted	The saturation is measured, its reading the record's; the stack and the illuminated dielectric settle together	0.1a
trilayer $Rb_2Pd_3Se_4$ (L908; SA-49): "highly insulating" for $0 < \mathcal{V}_{\mathrm{TG}} < 5$ V (L1059–L1060), "consistent with a fully filled flat-band state and a large bandgap in" "pristine $A_2T_3X_4$" (L1062–L1063; SA-74)	measured; quoted	Accepted, another compound and thickness than the spectroscopy's; the pristine reading seeds T-2	P-5
"a clear insulator-to-metal transition across" the band edge, "more than three orders of magnitude" (L1064–L1065, L1040; SA-68)	measured	Accepted: a two-terminal resistance with graphite contacts (L1277) at a 100-mV bias (L1298); the band's $n = 3$ closures leave or fill its modes and none changes class	I-5

record claim, continued	verb	FDT reading	clause
further hole doping: the high-temperature resistance continued to fall (L1047–L1048), the temperature dependence "developed an insulating character" (L1049), "a new insulator state within the partially filled flat" band (L1050; SA-69)	measured; quoted	The insulating trend is measured; its place in the flat band is the record's reading across compound and thickness; no closure changes class	I-5
"As trivial scenarios such as disorder-dominated insulating state" "are unlikely to occur beyond the band-metal regime", the state "may potentially indicate the onset of many-body effects" (L1051–L1053; SA-71)	quoted	The record's modal is kept; the overlap reading of the onset is retired for want of a map	I-1a
the capacitor model $\mathfrak{n} = (C_{\mathrm{BG}}\mathcal{V}_{\mathrm{BG}} + C_{\mathrm{TG}}\mathcal{V}_{\mathrm{TG}})/e$ (L1287) with 3.9 for both dielectrics (L1293), $\mathfrak{d}_{\mathrm{SiO_2}} = 285$ nm and $\mathfrak{d}_{\mathrm{hBN}} = 14$ nm (L1292), $\mathcal{V}_{\mathrm{BG}} = -90$ V (L1283; SA-98, SA-101)	estimated	Identity map: -1.5×10^{13} cm^{-2} at $\mathcal{V}_{\mathrm{TG}} = -5.5$ V (L1047), the Fig. 4e axis end (L845); by the manuscript's arithmetic the densities at −2.5 and −5.5 V reach 0.11 and 0.15 of the record's one-electron-per-cell density 1.0 nm^{-2} (L577, L932–L935, L1047)	—
"sophisticated Hall-bar geometries" and "ionic liquid gating or chemical doping" (L1060–L1061; SA-73)	quoted	The outlook that T-1 takes up	—

Corroboration. 0.1a reads the gating data as an exhibit of one settlement, on the record's own data and at its precision: a 390-meV span over 18.5 V of single-gate voltage at room temperature, saturating beyond −2.5 V in a device whose illuminated dielectric conducts (L1050–L1054, L1251–L1260). The transport is accepted as measured, its flat-band identification the record's. Falsifier

of the exhibit: a repeat of the record's gated monolayer whose flat-band energy kept following the gate where the record measures its saturation (L1053–L1054) would remove the saturation the exhibit reads; 0.1a's one settlement holds either way, for the clause names no objective and assigns no share of the gate's charge to the band, the dielectric or the graphitic layers.

3.5 Cluster 5: the theory (Table 1 and Fig. 5)

record claim (locus; register row)	verb	FDT reading	clause
Table 1's flat-band width, $\mathcal{W}_{2D} = 140$ meV against 10 meV (L728), and the "sufficiently flat" $\mathcal{W}_{2D} \approx 0.14$ eV (L1081; SA-28)	quoted (kind unstated)	A fourth width object, carried as Table 1's	—
Table 1's Coulomb interaction $\mathfrak{U}_C = e^2/4\pi\varepsilon_0\varepsilon_r\mathfrak{a}_{loc}$: 460 meV at $\mathfrak{a}_{loc} = 6.2$ Å, 19–35 meV at 52 Å (L729, L731; SA-31, SA-32, SA-33)	estimated	Identity map: 460 meV at $\varepsilon_r = 5$ (L1309; U-03, U-04); the moiré column needs ε_r between 7.9 and 15; each energy enters $\mathcal{M}$ once; no Coulomb scale from I-1 is written (O-6)	I-7, I-1
"comparable" $\mathfrak{U}_C/\mathcal{W}_{2D}$ (L738): $460/140 = 3.3$ (L728, L731) against 2 to 4, one figure, the 10 meV's (L735–L738; SA-37), the manuscript's arithmetic on L728 and L731	quoted	Energy scales that grow as the length shrinks, their ratio comparable at Table 1's two lengths, the record's comparison of two flat bands of different construction; a ratio of a Coulomb scale to a width is no ratio of the chain, and no core clause reads it	—
the "FQAH gap 14–29 meV" against "1–5 meV" (L733), the moiré column "adopted from ref. 42" (L744; SA-35, SA-81)	calculated; quoted	Carried as calculated; no temperature is attached to a gap here	—

record claim, continued (locus; register row)	verb	FDT reading	clause
the mean-field diagram of monolayer $Rb_2Pd_3S_4$ (L1030), its "120° triangle antiferromagnetism" (L1032) and the ferromagnet, "the well-known exact ground state of the kagome flat band at half-filling" (L1035); the d-orbital Hubbard scale $\mathfrak{U}_{\mathrm{H}} \approx 1$ eV (L1083; SA-64, SA-66, SA-76)	calculated; quoted	Calculated phases of an onsite-only model, carried as calculated; the ferromagnet is read through P-5, its exactness ref. 18's theorem, quoted; the Hubbard scale is the d-orbital scale the record states (L1081–L1083), no output of its calculations	P-5
"a nonzero Chern number", $\mathcal{C} = 1$ (L1090); the quantum metric and the Berry curvature (L1036; SA-67, SA-77)	calculated	Band geometry over crystal momentum: in the lift of Eq. (7) $\mathfrak{g}_{ij}$ sits on the scalar and $\mathcal{F}_{\boldsymbol{k}}$ on the bivector grade of one object, the manuscript's own pairing, for the record names no tensor joining the two; neither is $g_{\mu\nu}$, a spacetime curvature or an I-3a deviation	I-4
"a threefold quasidegenerate ground state" (L1102), "spectral flow consistent with the Laughlin-type fractional state" (L1103), "a calculated many-body Chern number of 1/3" (L1104), the return "only after the 6π flux insertion" (L1036; SA-65, SA-79)	calculated	The manuscript's reading, through I-5a's "same fractional-accounting mechanism as the FQHE": the record's Laughlin-type state is $K = (3)$, rank 1, its threefold degeneracy the $\lvert\det K\rvert = 3$ of the K-matrix account and its return's period $3 \times 2\pi$; the many-body 1/3 is the Hall readout, the charge covector paired with itself through K^{-1}, a reading, never a possession, and not the self-statistics 1/3 the clause names, the two equal only because the charge and quasiparticle vectors coincide in this rank-one basis; the strand ledger stays integral	I-5a
the premises: $\mathcal{N}_{\mathrm{ED}} = 21$ (L1529), $\varepsilon_{\mathrm{r}} = 5$ assumed (L1309), the screened potential with ℓ_{scr} decreased until "the results became insensitive" (L1307–L1308), at most "one electron to be excited" (L1312), the band "within the" ferromagnetic phase (L1300; SA-101, SA-103, SA-105, SA-107, SA-116)	calculated	They travel with every number the exact diagonalization produces	—
zone averages 0.88 and 0.76 against 0.11, which "remain in the same order of magnitude" (L1540–L1542), the kagome maxima "worse" (L1538; SA-117)	calculated	The ratios 8.0 and 6.9 are the manuscript's arithmetic: by the record's own measure the moiré band sits nearer the ideal condition	—
phenomena that "might be realized at much higher energy and" temperature scales (L1114–L1115; SA-82)	quoted	The record's modal is kept; its prospect rests on calculated gaps	—
a tight-binding model "fitted to the DFT" (L1268) that reproduces its bands, "validating its use" (L1578; SA-95, SA-121)	fitted; in-sample	In-sample: the fit reproduces the bands it was fitted to	—

Corroboration. The cluster is calculated, and the manuscript's Laughlin reading, through I-5a's fractional accounting, re-reads the calculation's own output: the record's threefold degeneracy and its return after 6π (L1036, L1102) are those of $K = (3)$, with $\lvert\det K\rvert = 3$, at the calculation's premises (L1300–L1312, L1529). The identity maps return Table 1's 460 meV (L731) and its ratios. Falsifier of the reading: an exact diagonalization of the same band at the record's premises on a larger system, whose ground states lost the threefold quasidegeneracy or returned to their configuration after fewer than three flux quanta, would remove the identification with $K = (3)$; a measured Hall response at a third of the band's filling other than one third of e^2/h tests the record's prospect for the material (L1112–L1116; SA-82), not this reading, and I-5a's integral ledger is untouched either way.

4 Cone-position translation

The record's band-structure objects translate into the confinement reading of I-5 and the cone orientation of I-3; the cone-position axis is A-4's token α_{conf}, a token with its range and nothing else (O-3).

record object (locus)	translation	clause
the Dirac point of the two lower bands (L767; Fig. 3i)	a band-structure cone whose vertex is the Dirac energy: on translation to a density cone the vertex is the tip, which carries high density and high energy	I-3
the flat band's top below the Fermi level (L33), within 420 meV of it in the monolayer (L932)	the cost $m_q c^2 = \hbar\omega_q$ of the topmost modes, read from the Fermi level; its place on the cone-position axis is the A-4 token	I-5
the flatness bounds (L773–L774)	a cost the pockets fix, which the crystal momentum moves by less than the bounds	I-5, P-2
the in-plane d_{xy} character and the absent out-of-plane dispersion (L776–L777)	a cost independent of out-of-plane momentum: the clamps lie in the plane	P-2, P-3
the band renormalization factor (L734, L1317)	a fitted ratio of two dispersions; no effective-mass formula and no address	I-5
the gate shift and its saturation (L1050–L1054)	the settlement moves the cost of every mode together	0.1a
the Chern band and its many-body state (L1090, L1104)	the band is a family of modes q of $n = 3$ closures; the many-body 1/3 is the Hall readout on the manuscript's $K = (3)$ reading, never a possession	I-5, I-5a

5 Predictions

The blocks stand where a core clause supplies what the consensus calculation lacks — a constitutive input (I-7) or a changed observable dictionary (P-5) — never a ratio, a chart or a branch tag alone (Use item 2). Each block names its divergence candidate and register row first, displays and solves its defining condition, and states its comparator, design, decision, executed rates, co-varying channels and ablation — the value with the FDT input in place against the value with that input at its consensus value. The core assigns none of these observables a magnitude, so every block is a sign or existence prediction, conditional by construction, its receipt encoding the sign as $+1$ against -1 with the sign threshold 1. The $\mathfrak{z} = 3$ rates are 0.00135 one-sided and 0.0027 two-sided (U-11), with $\mathfrak{z}$ the standard-normal deviate and z kept for the helical window's coordinate, and every small-sample threshold below is the binomial or Student value at that rate.

5.1 T-1: the twist's hand locks the zero-field anomalous Hall sign of twisted bilayers (DC-1, SA-10)

T-1 carries DC-1 and discriminates SA-10: the twisted kagome bilayers that "have been theoretically proposed to realize higher-order topology" (L167) in the record's outlook of strain- or twist-angle control (L164–L165), none of them made in the record. Warrant: P-5, a changed observable dictionary — "Imposing a physical twist (torsion, helical geometry) on a material *is* establishing a magnetic field." Observable: the sign of the zero-field anomalous Hall resistance $\mathcal{R}_{xy}$ of twisted bilayer $Cs_2Pd_3S_4$, read as its part odd under exchange of the current and voltage pairs, which removes the longitudinal admixture of a misaligned Hall pair by the measured four-terminal reciprocity (the standard account's Onsager–Casimir relation, which it premises on microscopic reversibility, a reading the convergence statement declines; the reciprocity used is the one measured on each device); the bilayer is two monolayers stacked at twist $\pm\Theta_0$ with $\Theta_0 = 10°$ for every device (U-12), away from 0° and 30°, where two hexagonal layers are their own mirror image and carry no hand (SA-47), gated to half filling of the flat band in ionic-liquid-gated Hall bars (the record's outlook names Hall-bar geometries and "ionic liquid gating", L1060–L1061). At half filling the record names flat-band ferromagnetism "the well-known exact ground state of the kagome flat

band at half-filling" (L1035; ref. 18; SA-64), a calculation for monolayer $Rb_2Pd_3S_4$ carried here to the bilayer of $Cs_2Pd_3S_4$ as the block's premise, the compound and the stack changed and said so.

FDT: the interlayer twist, read as P-5's physical twist (the manuscript's own reading), establishes the field. The bilayer at $\pm\Theta_0$ is its own image under a half turn about an in-plane axis, a proper rotation of its point group, which keeps the hand and reverses an out-of-plane field, so the twist alone fixes no sign of $\mathcal{R}_{xy}$; the device's polar axis, the normal from the substrate to the ionic liquid, supplies the direction (the manuscript's own reading), every device is built in that order, and the sign of $\mathcal{R}_{xy}$ referred to that axis is fixed by the hand $\operatorname{sgn}\Theta$. Which hand gives which sign the core does not assign, so the block predicts the lock and the separation of signs by hand, not the assignment; the core assigns the twist's field no magnitude (P-5's closing sentence), so the lock is predicted where that field exceeds B_{set} by more than the spread of the spontaneous choice, conditional by construction at $B_{\mathrm{set}} = 10$ µT (U-12). Comparator: a twisted stack is even under time reversal, so a locked device's sign is independent of its hand except through a time-odd process the hand joins — the fluxes and the cooling of the scope below — which the design leaves unlocked (the fluxes) or locked only at the rate of a spontaneous choice, on the hand's sign (the cooling, where its share of the slower cooldown's sign vanishes); the lock rate is 1/2 for a spontaneous choice, 0 for a sign the reversed set field or the reversed heat flow leads, and up to 1 for a sign a device-fixed bias leads, a local remanent field the nulling misses among them, so the hand–sign tables carry the decision against a device-fixed bias, the slower cooldowns' table against one the cooling overrides at the faster rate, which locks its device only where the hand's sign is the bias's, and the lock count against the cooling. The comparator's zero (Use item 7) is the hand-odd part of the slower cooldowns' signs: a response acting on both hands alike cancels in that table. With $s_j^{(1)}$ and $s_j^{(2)}$ the signs of $\mathcal{R}_{xy}$, referred to the polar axis, of device j after its first and second cooldown, $s_j^{(\mathrm{s})}$ the one after its slower, Θ_j its twist, $\varpi = \pm 1$ one assignment common to every device and Pr a binomial probability, the defining condition is

$$\begin{aligned} &\text{FDT:}\ \ s_j^{(1)} = s_j^{(2)} = \varpi \operatorname{sgn}\Theta_j \ \ \text{for every } j; \\ &\text{comparator:}\ \ \left(s_j^{(\mathrm{s})}\right)_j \text{ independent of } \left(\operatorname{sgn}\Theta_j\right)_j. \end{aligned} \tag{12}$$

Solved on the design below, the FDT condition locks every device, $\mathcal{L} = 16$, with both hand–sign tables separated $8 + 8$; the comparator leaves the signs after the slower cooldowns independent of the hands, jointly over the devices, with $\mathcal{L}$ anywhere from 0 to 16.

Design: 16 devices, 8 per hand, the hand of each fabrication slot drawn at random before the first device is built, so that a device-fixed bias that drifts over the fabrication enters both hands alike, each device built with its ionic liquid above the bilayer and the liquid frozen before the ordering range is crossed, so that no gate current flows across the bilayer; each cooled twice through the ordering range with the cryostat's residual field nulled and then set to $+B_{\mathrm{set}}$ and $-B_{\mathrm{set}}$, each referred, like $\mathcal{R}_{xy}$, to the polar axis, a heater on the substrate's back in one cooldown and on the frozen liquid in the other, the opposite face anchored to the cold stage, holding the heated face 1 K above it through the ordering range (U-12), so that the vertical heat flow through the bilayer reverses between the two cooldowns; the two cooldowns cross the ordering range at rates a factor of ten apart (which cooldown takes $+B_{\mathrm{set}}$, which the heater on the substrate's back, and which the slower rate, each randomised per device, drawn before the first cooldown); a device is "locked" when both cooldowns give one sign. The nulling addresses the cryostat's remanence, the randomised order a drift common to the session, and the reversed set field and the reversed heat flow make a residual-field-led and a flow-led sign unlocked by construction, the heater's pairing with the set field makes whether the flow adds to the set field or opposes it a draw independent

of the hand, so that a device-fixed bias above their difference and below their sum, which leads the slower cooldown only where the two oppose, leads it independently of the hand, and the two cooling rates leave the slower cooldown's sign independent of the hand where the cooling's share of it vanishes. Statistic and decision: reject the comparator iff the lock count $\mathcal{L}$ satisfies the one-sided binomial $\Pr(\mathcal{L}' \geq \mathcal{L} \mid 16, 1/2) \leq 0.00135$ (that is $\mathcal{L} \geq 15$, where the tail is 0.00026, against 0.0021 at $\mathcal{L} \geq 14$) and the hand–sign table of the locked devices, and that of all sixteen devices' slower cooldowns, each has a two-sided Fisher exact $p \leq 0.0027$, two-sided as the sum over the tables no more probable than the observed one (perfect separation gives 0.00016 at $8 + 7$ and at $8 + 8$; $7 + 7$ fails the lock count). A second set of 16 devices, built afresh, decides by the same rule with the Fisher tests one-sided at 0.00135 in each direction, a rejection opposite to the ϖ the first set fixed contradicting the block; its executed rates under U-13, either direction counted, are the first set's. Executed under the noise model of U-13, 20 000 trials per point: comparator rejection 0 at each of the three comparator points (random sign; residual-field-led; random with 5 % misread signs) and 0 with a hand-odd flow bias of 2 in the units of U-13 reversed between the cooldowns, its pairing with the set field drawn per device, against 1.00 with that bias held in one direction, and rejection at the FDT point 1.00 (0.87 with 2 % misread signs); computed exactly, with every device locked by a device-fixed bias whose sign is independent of the hand and fair, the rejection is 0.00052 (the second set's, in the direction the first fixed, 0.00026), and under every bias that leaves the slower cooldowns' signs independent of the hand, a device-fixed bias, a drift over the fabrication and a device-fixed bias the cooling overrides at the faster rate among them, the randomised hands hold it to the conditional size of the slower cooldowns' Fisher test, at most $1/715 = 0.0014$, reached where all sixteen devices lock and their signs split 9 to 7, within the two-sided 0.0027, whereas the lock count and the locked devices' table alone reject $1/198 = 0.0051$ under eight slots of a bias that leads both cooldowns and eight of the other sign that the cooling overrides at the faster rate; with a hand-locked cooling-borne bias that leads the faster cooldown and whose share of the slower cooldown's sign vanishes, a device locks at the rate $1/2$ and the decision rejects 0.00026, while a bias of 2 in the units of U-13 at the faster rate and so 0.2 at the slower, against the set field's 0.1, locks a device at the rate 0.74 and the decision rejects 0.050, a bias of 0.9 at the faster rate and so 0.09 at the slower, below the set field, locks a device at the rate 0.61 and the decision rejects 0.0041, and a bias of 20 at the faster rate and 2 at the slower, leading at both, makes the decision reject 1.00. Single-channel scope: the set field enters the comparator by design, the spontaneous choice is the comparator's own, and misreads enter the executed rates; at zero field the consensus account couples the hand to the sign through one channel, a flux along the twist axis — the heat flow of a cooldown, a gate current — which in the chiral bilayer couples to the moment along that axis with a coefficient odd in the hand (the coupling measured as heat-driven phonon angular momentum in quartz [6] and as current-induced magnetization in tellurium [7]), and the frozen gate and the reversed heat flow leave those two fluxes no locked sign; the cooling itself, of one sign in every cooldown, joins the hand and the device's polar axis in a bias of the symmetry the manuscript's reading gives the twist's field (a displacement current of the polar stack along its axis, turned into a moment by the same hand-odd coupling), which neither the frozen gate nor the reversed heat flow removes and which falls with the cooling rate, so a sign the cooling leads at the faster rate only takes at the slower the sign of the set field, the flow and the spontaneous choice together, the set field's sign and the flow's pairing with it drawn independently of the hand, and locks at the rate of a spontaneous choice, while the twist's field, independent of the rate, locks at both, the slower rate being one at which the cooling's share of the sign vanishes, a premise on the comparator that the design does not test and that fails toward a false rejection, the set field's lead over that share sufficing only where it exceeds the share by several spreads of the spontaneous choice, which U-13's spread, wider than the set field, rules out, and a cooling that leads at both rates locking every

device on the hand's sign, whereas the block's own condition at B_{set} fails toward a lost power; the measuring current, in plane, couples to no out-of-plane moment at linear order, the bilayer keeping its half turn about the normal; so, on that premise, the twist's field is the one channel that locks every device's sign to the hand. Ablation: with the twist's field in place the encoding is $+1$, every device's sign locked to the hand; with that input at its consensus value, zero, it is -1; their difference, 2, exceeds the sign threshold 1.

5.2 T-2: static torsion makes a torsion-odd stray field over a pristine ribbon (DC-2, SA-74)

T-2 carries DC-2 and discriminates SA-74: the record reads its trilayer's insulating response as "consistent with a fully filled flat-band state and a large bandgap in" "pristine $A_2T_3X_4$" (L1062–L1063), and its outlook names "strain and twist-angle engineering" (L1123); no torsion is applied in the record. Warrant: P-5, a changed observable dictionary — static torsion is the "torsion" of P-5's "physical twist (torsion, helical geometry)". Observable: the torsion-odd stray field B_{odd} above a suspended pristine monolayer $Cs_2Pd_3S_4$ ribbon 10 µm long and 2 µm wide (U-14), assembled and measured without exposure to air or solvent (the record's exposed flake "displays a much broader spectrum" with a binding-energy shift, "indicating clear signs of degradation", L771–L772), held at zero applied field in magnetic shielding, one clamp rotated to $\pm\Theta_{\mathrm{c}}$ with $\Theta_{\mathrm{c}} = 5^{\circ}$ (U-14), read at the ribbon's centre by scanning SQUID magnetometry in a flux-locked loop, which returns the signed field at zero applied field and puts no light and no microwave drive on the ribbon; a scanning NV centre at zero applied field returns the same pair of resonances at a field and at its reverse, so it reads no torsion-odd sign, and a bias field is no remedy, because the moment it induces in the ribbon turns with the $\pm\Theta_{\mathrm{c}}/2$ tilt of the ribbon's centre and reads odd in the torsion sense. The pristine monolayer is taken as the record's pristine state, which the record reads from its trilayer $Rb_2Pd_3Se_4$ device (SA-49): compound and thickness changed and said so. FDT: static torsion establishes a field (P-5), $B_{\mathrm{odd}} \neq 0$ with its sign set by the torsion sense; no twist-to-moment form is derived here and the core assigns no number, so the block is a sign and existence prediction, conditional by construction. Comparator: zero — static torsion is even under time reversal and the pristine monolayer is nonmagnetic. The comparator's zero (Use item 7) is the same sequence with the ribbon cut at the rotated clamp and the clamp rotated, a torsion-free comparator, the same medium left untwisted, that enters the statistic: a torsion-odd background of the clamp acts on the ribbon and on the cut ribbon alike and cancels in the difference where the cut leaves it unchanged, the cut ribbon's cycles necessarily following the ribbon's, and a change of a tenth of a reading standard deviation across the cut raises the comparator's rejection to 0.021. With $B(\pm\Theta_{\mathrm{c}})$ the field read at the two clamp angles, $\bar{\mathfrak{b}}_{\mathrm{rib}}$ and $\bar{\mathfrak{b}}_{\mathrm{cut}}$ the mean per-cycle odd differences over the 100 cycles on the ribbon and the 100 on the cut ribbon (U-14), $\mathrm{var}_{\mathrm{rib}}$, $\mathrm{var}_{\mathrm{cut}}$ their sample variances and $\mathcal{S}_{\mathrm{W}}$ the Welch statistic of the two means,

$$B_{\mathrm{odd}} = \big[B(+\Theta_{\mathrm{c}}) - B(-\Theta_{\mathrm{c}})\big]/2, \qquad \mathcal{S}_{\mathrm{W}} = \frac{\bar{\mathfrak{b}}_{\mathrm{rib}} - \bar{\mathfrak{b}}_{\mathrm{cut}}}{\sqrt{\mathrm{var}_{\mathrm{rib}}/100 + \mathrm{var}_{\mathrm{cut}}/100}}; \tag{13}$$

solved, the FDT condition is $\operatorname{sgn} B_{\mathrm{odd}} = \varpi_{\mathrm{c}} \operatorname{sgn} \Theta_{\mathrm{c}}$ with $|B_{\mathrm{odd}}| > 0$ on the ribbon and zero on the cut ribbon, each net of the clamp's own torsion-odd background, which both carry alike where the cut leaves it unchanged, $\varpi_{\mathrm{c}} = \pm 1$ unassigned, and, net of that background, the comparator is $B_{\mathrm{odd}} = 0$ on both. Design: 100 cycles on the ribbon and 100 on the cut ribbon, alternating $(+\Theta_{\mathrm{c}}, -\Theta_{\mathrm{c}})$ and $(-\Theta_{\mathrm{c}}, +\Theta_{\mathrm{c}})$, so that a drift linear in time, which a fixed order leaves in every odd difference, cancels over each pair of cycles; statistic $\mathcal{S}_{\mathrm{W}}$, the ribbon's mean per-cycle odd difference minus the cut ribbon's over the Welch standard error of the two means, with Welch–Satterthwaite

degrees of freedom; decision two-sided at the $\mathfrak{z} = 3$ rate with the Student critical value at those degrees of freedom (3.04 at 198). A second ribbon decides by the same statistic one-sided at the $\mathfrak{z} = 3$ rate in each direction, with the same critical value, a rejection opposite to the ϖ_{c} the first fixed contradicting the block. The two sequences are independent, so the two means' covariance is zero; within a cycle a drift common to both readings cancels in the odd difference. Single-channel scope: the clamp's own background and a drift common to a cycle cancel as stated; the two clamps, the sensor and the radiation shield around the ribbon are held at one temperature and the sensor puts no light on the ribbon, because a heat or charge flux along a twisted ribbon couples to the moment along its axis with a coefficient odd in the torsion sense (the coupling of T-1's scope [6, 7]), a field the ribbon would carry and the untwisted cut ribbon would not; and at zero applied field and zero flux no consensus channel of the pristine ribbon is odd in the torsion sense — piezomagnetic and flexomagnetic responses need a broken time reversal that the nonmagnetic ribbon lacks, and an induced moment vanishes with the applied field — so, on the premises that no heat flows along the ribbon and that the cut leaves the clamp's background unchanged, the torsion's own field is the one channel the statistic reads. Computed exactly under U-14, each cycle's odd difference Gaussian and independent of the others': comparator rejection 0.0027 with or without a torsion-odd clamp background of 0.3 reading standard deviations, which cancels in the difference, against 0.0027 nominal; the ribbon's mean alone rejects 0.85 under that background and is not used; at a ribbon field of 0.5 reading standard deviations the decision rejects 0.97. Ablation: with the torsion's field in place the encoding is $+1$; with that input at its consensus value, zero, it is -1; their difference, 2, exceeds the sign threshold 1.

5.3 T-3: at a positive, dominating density sensitivity the Pd isotope moves the flat band against the Dirac point in the sign the comparator excludes (DC-3, SA-25)

T-3 carries DC-3 and discriminates SA-25: the record reads the d_{xy} band width as "reflecting stronger electronic hopping in 4d orbitals" (L723) and holds its $A_2Pd_3S_4$ data at one photon condition (L1193, L1250); no isotope is varied in the record. Warrant: I-7, a constitutive input. Observable: $E_{\mathrm{FD}} = E_{\mathrm{FB}} - E_{\mathrm{DP}}$, the flat-band top E_{FB} relative to the Dirac point E_{DP}, in $Cs_2Pd_3S_4$ grown from enriched ^{104}Pd and from enriched ^{110}Pd by the record's flux method, read by micro-ARPES at the record's photon energy and polarization (98 eV, linear horizontal, second zone; L1250, L1193) below 20 K (L1243), both isotopes alternated in one session. FDT input, the Discriminator: "For purely density-coupled equilibrium observables, a heavier isotope $\rightarrow$ larger R_s $\rightarrow$ higher α $\rightarrow$ larger response — opposite in sign to conventional reduced-mass scaling". Each isotope's mass is a confinement eigenvalue of its own nucleus, a bound configuration to which the heavier isotope adds neutrons, the $n = 2$ closure read from the nuclear room (I-5); the AME2020 values of U-08 supply the masses and no form of D derives them here (O-9). Isotope substitution is a fixed-geometry perturbation (I-3 chart discipline 5): the lattice constants of both isotopes are measured and any difference enters as its own geometric channel (SA-19). At fixed geometry the density channel's input to Eq. (14) is the A-1 step at fixed r_f of the declared flake of U-10, the same for every flake of that composition, the measured ones among them: $\Delta \ln \alpha_{\mathrm{ext}} = \Delta \ln \mathcal{M} = 0.0252$ per formula unit for fully enriched lots (U-07, U-08; [3, 4]), and the value the lots' assayed isotopic composition gives otherwise; it is the logarithmic shift of the output of the map of Eq. (9), whose odds-enhancing input is the x the framework derives from the fractional step $\Delta_{\mathcal{M}}$, kept distinct from that step and from the logarithmic shift (I-7 discipline 4). The density channel's input sign is the Discriminator's; the observable's sign is that of the sensitivity-weighted sum, with $S_{\mathrm{dens}} = \partial \ln E_{\mathrm{FD}} / \partial \ln \mathcal{M}$ at fixed geometry, fixed zero-point amplitudes and fixed nuclear skin

radius R_{room}, $S_{\mathrm{geo}} = \partial \ln E_{\mathrm{FD}} / \partial \ln \mathfrak{a}_{\mathrm{cell}}$ at fixed $\mathcal{M}$, fixed zero-point amplitudes and fixed R_{room}, $S_{\mathrm{ZP}} = \partial \ln E_{\mathrm{FD}} / \partial \ln m_{\mathrm{iso}}$ through the zero-point amplitudes at fixed $\mathcal{M}$, geometry and R_{room}, m_{iso} the substituted species' mass, and $S_{\mathrm{clamp}} = \partial \ln E_{\mathrm{FD}} / \partial \ln R_{\mathrm{room}}$ through the substituted nuclei's skin radius R_{room} at fixed $\mathcal{M}$, cell and zero-point amplitudes:

$$\begin{aligned} \Delta \ln E_{\mathrm{FD}} = S_{\mathrm{dens}} \, \Delta \ln \mathcal{M} + S_{\mathrm{geo}} \, \Delta \ln \mathfrak{a}_{\mathrm{cell}} \\ + S_{\mathrm{ZP}} \, \Delta \ln m_{\mathrm{iso}} + S_{\mathrm{clamp}} \, \Delta \ln R_{\mathrm{room}}, \end{aligned} \tag{14}$$

which "stays conditional until the sensitivities are established" (I-7 discipline 2): the Discriminator fixes the input sign, $\Delta \ln \mathcal{M} > 0$, and the sign of S_{dens} stays conditional, so the block's test point is $S_{\mathrm{dens}} > 0$, the larger response read as a larger E_{FD}; the block is conditional by construction, its receipt encoding the sign. Comparator: the consensus zero-point isotope shift of the substituted species, whose sign s_{ZP} is fixed beforehand by a species-resolved consensus calculation of the zero-point renormalization of E_{FD} (the electron–phonon term at fixed geometry, weighted by the substituted species' displacements, and the volume term, the lattice-constant difference the geometric channel measures before the session weighted by the calculation's own S_{geo}, so that the zero-point volume change enters once, with the field shift of the isotopes' nuclear sizes and the finite-nuclear-mass correction of the electronic problem; U-19), a calculation that also returns the consensus shift $\Delta E_{\mathrm{FD}}^{\mathrm{cons}}$ with its uncertainty — never by the total temperature shift, a sum over every species' modes that a single-species substitution need not share in sign. Solved, Eq. (14) gives $\operatorname{sgn} \Delta E_{\mathrm{FD}} = \operatorname{sgn} S_{\mathrm{dens}}$, heavier isotope minus lighter, wherever $|S_{\mathrm{dens}} \Delta \ln \mathcal{M}|$ exceeds the consensus terms together, the terms the comparator's calculation carries; the block discriminates where the species-resolved calculation fixes s_{ZP} negative (its $\Delta E_{\mathrm{FD}}^{\mathrm{cons}}$ below zero by $\mathfrak{z} = 3$ of its own standard uncertainties), the sign opposite to the density share's at the block's test point, a sign no scaling rule fixes for a difference of hopping-set band energies such as E_{FD}; where it fixes s_{ZP} positive by the same criterion, the density share and the comparator carry one sign, the ablation is INERT and DC-3 takes a RETIRED row with those numbers; where its $\Delta E_{\mathrm{FD}}^{\mathrm{cons}}$ lies within $\mathfrak{z} = 3$ standard uncertainties of zero, it fixes no sign, no session is run and DC-3 stays prospective until a calculation fixes one. Refutation: a measured ΔE_{FD} that, raised by the lots' bound, stands below $\Delta E_{\mathrm{FD}}^{\mathrm{cons}}$ by the one-sided $\mathfrak{z} = 3$ Welch criterion, the calculation's uncertainty added to the variance in quadrature, is a negative density share and refutes the block's test point $S_{\mathrm{dens}} > 0$; a measured shift within the criterion of $\Delta E_{\mathrm{FD}}^{\mathrm{cons}}$ bounds the density share $S_{\mathrm{dens}} \, \Delta \ln \mathcal{M} \, E_{\mathrm{FD}}$ by the criterion's width and the lots' bound.

channel	handling	sign of its share of ΔE_{FD}
density, $\Delta \ln \mathcal{M} = 0.0252$	the FDT input at fixed geometry	$\operatorname{sgn} S_{\mathrm{dens}}$, its input sign the Discriminator's; positive at the block's test point
zero-point renormalization	the comparator, fixed before the session (U-19)	$\operatorname{sgn}(S_{\mathrm{ZP}} \Delta \ln m_{\mathrm{iso}})$, carried in s_{ZP}, the sign of the comparator's total
lattice constant	measured on every growth before the session, its own channel, the mean difference over the growths, with its spread, weighted by the comparator's calculated S_{geo}	$\operatorname{sgn}(S_{\mathrm{geo}} \Delta \ln \mathfrak{a}_{\mathrm{cell}})$, carried in s_{ZP}
nuclear size	the two isotopes' charge radii differ [5]: one term, $S_{\mathrm{clamp}} \Delta \ln R_{\mathrm{room}}$ of Eq. (14), its value the field shift the comparator computes, read on the FDT side as I-5's boundary data at the P-3 clamps (the manuscript's own reading)	carried in s_{ZP}
finite nuclear mass	the consensus electronic problem's nuclear-mass correction, computed in the comparator	carried in s_{ZP}
enrichment and lot chemistry	each enriched lot assayed for isotopic composition and impurities, and the two lots brought to one impurity specification before the growths; with one lot per isotope a lot difference is common to every growth of that isotope, no growth re-sets it and no number of growths shrinks it, so the comparator's calculation carries the two lots' assayed impurity levels into a bound on their share of ΔE_{FD}; $\Delta \ln \mathcal{M}$ and $\Delta \ln m_{\mathrm{iso}}$ computed from the assay	within the lots' bound, which the decision subtracts; outside the Welch variance
surface and charge state	one substrate and one anneal for both isotopes (the record's Nb-$SrTiO_3$ substrate and 250 °C anneal, L1199–L1204), the Fermi-edge position and S-2p core-level width recorded per flake, the $\bar{\mathrm{K}}$ cut set by one alignment procedure	rigid share cancels in E_{FD}; the rest in the Welch variance
temperature	both isotopes below 20 K (L1243), alternated in one session	held
growth- and flake-to-flake offset	re-set by every flake, each cut from its own growth	in the Welch variance

Design and decision: 12 flakes per isotope, each cut from its own growth, so that the growth, the unit to which the isotope is assigned, is also the unit of replication, the two isotopes' growths interleaved in the furnace runs in an order drawn at random before the first growth, from one assayed lot of each enriched starting material; Welch statistic on the isotope difference less the lots' bound, with Welch–Satterthwaite degrees of freedom; one-sided at the $\mathfrak{z} = 3$ rate in the direction the comparator excludes (Student critical value 3.38 at the 22 degrees of freedom of equal variances). The variance carries the growth-to-growth and flake-to-flake components that each flake re-sets; under U-15 the Welch statistic at 12 flakes per isotope is the pooled Student statistic and its Welch–Satterthwaite degrees of freedom never exceed 22, so the decision rejects only where the Student test at 3.38 does: computed exactly over the distribution of the variance ratio, it rejects 0.00125 against 0.00135 at the comparator's boundary $\Delta E_{\mathrm{FD}}^{\mathrm{cons}} = 0$ with the lots' share at its bound, and less where that share stands inside, a fit-error-only variance rejects 0.09 and is not used, and at a difference of 2 flake standard deviations the decision rejects 0.81 at a zero bound. Ablation, at the test point of a positive, dominating S_{dens} and a negative s_{ZP}: with the density channel in place the encoding is +1, the sign the comparator excludes; with that input at its consensus value, zero, the

observable's sign is the comparator's, -1; their difference, 2, exceeds the sign threshold 1.

5.4 T-4: at a positive, dominating density sensitivity the Rb isotope moves the same observable in the sign the comparator excludes (DC-4, SA-53)

T-4 carries DC-4 and discriminates SA-53: the record reads its crystals' colours as "indicating that the electronic structure and optical bandgap are widely" "tunable by varying the transition metal or chalcogen site, whereas the" "alkali metal site plays a marginal role" (L591–L593; ref. 35), and it compiles its thickness series across two Alk sites on that premise (L921–L922). Warrant: I-7, a constitutive input. Observable: E_{FD} as in T-3, in $Rb_2Pd_3S_4$ grown from enriched ^{85}Rb and from enriched ^{87}Rb, with T-3's photon condition, temperature and alternation. FDT: the Alk mass enters $\mathcal{M}$ once (0.5, I-7) and moves the density channel with the Discriminator's input sign at fixed geometry, $\Delta \ln \alpha_{\mathrm{ext}} = \Delta \ln \mathcal{M} = 0.00645$ per formula unit for fully enriched lots (U-07, U-08), the A-1 step at fixed r_f of any $Rb_2Pd_3S_4$ flake, A-1 being linear in $\mathcal{M}$ there as for the declared flake of U-10, through Eq. (14) with m_{iso} the Rb mass. Comparator: the consensus zero-point shift through the Alk modes, its sign and value fixed as in T-3 (U-19). Solved: $\operatorname{sgn} \Delta E_{\mathrm{FD}} = \operatorname{sgn} S_{\mathrm{dens}}$ where the density term dominates, positive at T-3's test point $S_{\mathrm{dens}} > 0$, discriminating where s_{ZP} is negative, as in T-3; the comparator gives s_{ZP} and $\Delta E_{\mathrm{FD}}^{\mathrm{cons}}$. Channels, refutation and the decision's rule are T-3's, with T-3's randomised furnace order and its handling of the lots, one assayed lot of each enriched Rb starting material and the bound the comparator's calculation sets on their share of ΔE_{FD}; the design is 150 flakes per isotope, each cut from its own growth, Welch with Welch–Satterthwaite degrees of freedom, one-sided at the $\mathfrak{z} = 3$ rate in the direction the comparator excludes (Student critical value 3.03 at the 298 degrees of freedom of equal variances); through Eq. (14) with one S_{dens}, one E_{FD} and one flake standard deviation (U-15) for the two compounds, the density share at which T-3's power is executed, a difference of 2 flake standard deviations for Pd, is for Rb $2 \times 0.00645/0.0252 = 0.51$ flake standard deviations, which T-3's 12 growths per isotope would reject at only 0.022; the 150 growths per isotope reject it at 0.83 at a zero lot bound and at 0.71 at a bound of 0.05 flake standard deviations, and, computed exactly over the variance ratio as in T-3, the size at the comparator's boundary is 0.00135 where the lots' share stands at its bound. Ablation, at T-3's test point, a positive, dominating S_{dens} and a negative s_{ZP}: $+1$ with the density channel in place, -1 with it at its consensus value, zero; their difference, 2, exceeds the sign threshold 1.

5.5 T-5: at a positive, dominating density sensitivity the S isotope moves the optical gap in the sign the comparator excludes (DC-5, SA-19)

T-5 carries DC-5 and discriminates SA-19: the record calls the system "a semiconductor with a bandgap in the visible light range" (L588) and prints no gap value; the record reads the "flatness of the quasiflat band" as "more strongly affected by the" Ch atoms (L725), which "set the ratio between nearest-neighbour and" longer-range hoppings (L727; SA-27). Warrant: I-7, a constitutive input. Observable: the absorption onset $E_{\mathrm{opt}} = E_{\mathrm{qp}} - E_{\mathrm{exc}}$, with E_{qp} the gap from the flat-band top to the d_{zx} conduction-band minimum, the orbital make-up being DFT's (SA-109), and E_{exc} the exciton binding energy, in $Cs_2Pd_3S_4$ grown from enriched ^{32}S and from enriched ^{34}S, read by low-temperature absorption on bulk-like flakes of one thickness window on one substrate. FDT input, design, decision, refutation and executed rates are T-3's with E_{opt} in place of E_{FD} in Eq. (14): $\Delta \ln \alpha_{\mathrm{ext}} = \Delta \ln \mathcal{M} = 0.0111$ per formula unit for fully enriched lots (U-07, U-08) at fixed geometry, the power executed at a density share of 2 flake standard deviations (U-15), the sensitivity of E_{opt} being its own. Comparator: the sign and value of the species-resolved calculation of the isotope

shift of E_{qp} less that of E_{exc}, the exciton–phonon renormalization of the binding entering once (U-19); T-3's channels carry over, its photoemission surface-and-charge-state row read for absorption as one substrate and one thickness window for both isotopes, with one more, the exciton binding, computed in the comparator and held by that thickness window and substrate. The measured anion isotope coefficients of *sp*-bonded gaps are positive, $+0.79 \pm 0.05$ meV/amu for the free exciton of β-ZnS and 0.71 to 0.95 meV/amu for S in CdS (U-21) [8, 9], and at that sign the ablation is INERT and DC-5 takes a RETIRED row; the optical gap of monolayer MoS_2, a *d*–*d* gap, is reported to move the other way with the mass of its cation, Mo, a red shift of 13 ± 7 meV from ^{92}Mo to ^{100}Mo (U-21), through the exciton–phonon renormalization of the monolayer exciton's binding [10]; that datum is a cation substitution in a monolayer and no anion coefficient of a *d*–*d* gap is quoted here, so no measured class fixes s_{ZP} for the S substitution in the *d*–*d* gap of bulk-like $Cs_2Pd_3S_4$, and the species-resolved calculation does. Solved: $\operatorname{sgn}\Delta E_{\mathrm{opt}} = \operatorname{sgn} S_{\mathrm{dens}}$ where the density term dominates, positive at the test point $S_{\mathrm{dens}} > 0$, discriminating where s_{ZP} is negative, as in T-3; the comparator gives s_{ZP} and $\Delta E_{\mathrm{opt}}^{\mathrm{cons}}$. Ablation, at the test point of a positive, dominating S_{dens} and a negative s_{ZP}: $+1$ with the density channel in place, -1 with it at its consensus value, zero; their difference, 2, exceeds the sign threshold 1.

5.6 T-7: a twisted heterotrilayer and its mirror image differ by a time-odd Kerr rotation (DC-8, SA-47)

T-7 carries DC-8 and discriminates SA-47: the record "determined the twist angle between graphene and A2Pd3S4" (L790) "to be 28.9° and that between A2Pd3S4 and graphite to be 20.2° for this" (L791) "specific heterotrilayer" (L792); the twist sense of each interface is not stated. Warrant: P-5, a changed observable dictionary. Observable: the zero-field polar Kerr rotation Φ_{Kerr} of graphene/$Cs_2Pd_3S_4$/graphite heterotrilayers with a monolayer kagome flake, pristine (ungated, flat band fully filled) — a few-layer flake in the Fmmm stacking the record's bulk calculations take as the most prevalent polymorph (L1467–L1468) loses the monolayer's sixfold axis (L1554–L1556) — assembled with both interfaces turned in one sense at the record's two twists, $(+28.9°, +20.2°)$, and as its mirror image, $(-28.9°, -20.2°)$, read by zero-area Sagnac interferometry, which in linear response reads only time-reversal-odd rotation, at low temperature after zero-field cooling, at four incident powers, 1/4, 1/2, 3/4 and 1 of the session's power, each stack's rotation taken as the zero-power intercept of its weighted fit quadratic in the power. Modulo the 60° of graphene and of the kagome monolayer, the mirror image of the graphene interface lies at 31.1°, 1.1° from the achiral 30°, and that of the graphite interface at 39.8°; the Bernal graphite repeats only every 120°, and the Brillouin-zone orientation, repeating every 60°, reads the sense of its twist and not its registry, which the kagome monolayer's sixfold axis makes immaterial to the interface; the stack's hand is carried by both interfaces together. With $\Phi_{\mathrm{Kerr}}(\mathrm{stack})$ and $\Phi_{\mathrm{Kerr}}(\mathrm{mirror})$ the two hands' rotations, Φ_{odd} their odd part and $\varpi_{\mathrm{h}} = \pm 1$ unassigned,

$$\begin{aligned} &\Phi_{\mathrm{odd}} = \big[\Phi_{\mathrm{Kerr}}(\mathrm{stack}) - \Phi_{\mathrm{Kerr}}(\mathrm{mirror})\big]/2; \\ &\text{FDT:}\ \ \operatorname{sgn}\Phi_{\mathrm{odd}} = \varpi_{\mathrm{h}},\ \ |\Phi_{\mathrm{odd}}| > 0; \qquad \text{comparator:}\ \ \Phi_{\mathrm{odd}} = 0. \end{aligned} \tag{15}$$

FDT: the stack, both interfaces turned in one sense, is read as a helical geometry, P-5's physical twist (the manuscript's own reading), and establishes a field, so $\Phi_{\mathrm{odd}} \neq 0$, its sign set by the stack's hand and referred to the layer order, graphene above graphite, every stack built in that order and read from its graphene face (the manuscript's own reading, as in T-1); no magnitude is assigned (no twist-to-moment form is derived here; P-5's closing sentence), a sign and existence prediction, conditional by construction. Comparator: zero at zero power — a stack's natural optical activity is even under time reversal and gives no polar Kerr rotation at normal incidence, and neither the

pristine flake nor the graphitic layers carry a spontaneous moment. The comparator's zero (Use item 7) is the mirror-odd difference itself: a mirror-even response acts on a stack and its mirror alike and cancels, and the Sagnac readout is blind to time-reversal-even rotation. Single-channel scope: the probe light is the consensus channel odd under both time reversal and the mirror — the light the stack absorbs drives a heat flux and a photocarrier flux normal to it and deposits the photon angular momentum its circular dichroism selects, and in a chiral stack each makes a moment of the stack's hand that grows with the power and is absent at zero power, where the intercept is read, the fit quadratic in the power removing such a moment wherever it is linear or quadratic in the power over the four powers; of a share growing as the square root of the power, as a photocarrier density held by bimolecular recombination does, the fit leaves 0.27 of the full-power value, of a cubic share 0.18 and of a quartic share 0.37 (U-18), which the statistic reads as the twist field, a light-borne hand difference of two offset standard deviations at full power raising the comparator's rejection to 0.035, 0.015 and 0.086 in the three cases; at zero power, after zero-field cooling, at zero applied field and with the stack and its surroundings at one temperature, so that no heat flows through it, no consensus channel of the pristine stack is odd under both time reversal and the mirror — natural optical activity is time-even and unread by the Sagnac, and a magneto-optical rotation needs an applied field or a spontaneous moment, neither of which the consensus account gives the stack — the stack-to-stack offset enters the Welch variance, and a mirror-even response cancels in Φ_{odd}, so, on the premises that the light-borne moment is linear or quadratic in the power over the four powers and that no heat flows through the stack, the stack's twist field is the one channel the statistic reads; a residual heat flux through the stack, of one direction relative to the layer order in every stack and reversed by nothing in the design, whereas T-1's heater swap reverses its own, enters every intercept with the twist field's signature, and a hand difference of half an offset standard deviation from it raises the comparator's rejection to 0.029. Design and decision: 32 stacks per hand, the hand of each assembly slot drawn at random before the first assembly, so that an offset that drifts over the assemblies enters both hands alike, each stack's two angles read after assembly from its Brillouin-zone orientations, the record's method (L789–L791), a stack whose graphene interface lies on the far side of the achiral 30° from its hand's, the margin being 1.1°, replaced by a fresh assembly before the session, and the stacks read in one order drawn at random before the session, so that a drift of the interferometer's offset over the session enters both hands alike; Welch statistic on the two hands' mean zero-power intercepts with Welch–Satterthwaite degrees of freedom, two-sided at the $\mathfrak{z} = 3$ rate; the variance carries the stack-to-stack offset each assembly re-sets. A second session of 32 stacks per hand, assembled afresh, decides one-sided at the $\mathfrak{z} = 3$ rate in each direction, a rejection opposite to the ϖ_{h} the first fixed contradicting the block. Computed exactly under U-18 over the two hands' sample variances, on the zero-power intercepts, the reading standard deviation 0.3 offset standard deviations at the session's power, scaling as the inverse square root of the power at one reading time per power: two-sided Welch rejection 0.0027 with equal offsets and 0.0027 with the mirror stacks' offsets 1.5 times larger, against 0.0027 nominal; a light-borne hand difference linear or quadratic in the power cancels in every intercept, while the full-power readings alone, which are not used, reject such a difference of two offset standard deviations at 1.00; and at a twist-borne hand difference of two offset standard deviations the decision rejects 0.93. Ablation: with the stack's twist field in place the encoding is +1; with that input at its consensus value, zero, it is −1; their difference, 2, exceeds the sign threshold 1.

5.7 The retired candidates

DC-6 (SA-69), the flat-band filling at which a correlated insulating state sets in, read against the I-1a threshold of the overlap-contrast application A-3, is retired: the core constructs no geometric

odds for A-3, so no map from a filling to α_{ovl} is displayed and none is used (O-2).

DC-7 (SA-66), the bond-resolved spin correlations of a kagome triangle read through P-4's many-cone ruling, is retired: the core supplies no map from a site's moment to its cone's flow direction, and a map that sets every moment on one axis with a two-valued sense admits only parallel and antiparallel bonds, against the measured non-collinear triangular orders of the kagome antiferromagnets Mn_3Sn [11], listed in the record's Fig. 1a (L75) and the subject of its ref. 4, "a non-collinear antiferromagnet" (L1081), and $KFe_3(OH)_6(SO_4)_2$ [12]; with such a map P-4's sign rule enters no bond's value, and no form of how a lattice's settlement signs a pair it does not join is written here (O-5).

6 Cross-domain

The record's exhibits connect to other domains through the same clauses, none by a transferred number. P-5 reads a torsioned ribbon (T-2) and, through the manuscript's reading of an interlayer twist as a physical twist, a twisted bilayer (T-1) and a twisted heterotrilayer (T-7) as one statement: a physical twist establishes a field whose sign follows the hand, its direction supplied, on the manuscript's own reading (T-1), by what the configuration carries beyond the hand — the device's polar axis for the bilayer, the layer order for the heterotrilayer, and for the ribbon the face the sensor reads, the field above its centre reversing below it. I-7 reads the isotope blocks (T-3 to T-5) and the pressure-induced transitions the record's references name for $Rb_2Pd_3Se_4$ (ref. 32 of the record, L1154–L1156) and for layered kagome chalcogenides (ref. 33, L1157–L1158) as one density mechanism through $\mathcal{M}$ and R_s; pressure loads the interstitial packing between the clamps (P-3), whereas an isotope at fixed geometry moves compactness only (I-3 chart discipline 5), its change of the nuclei's charge radii entering Eq. (14) as the separate clamp term, which is why the isotope blocks measure the lattice constants of both isotopologues and carry the nuclear-size channel. P-2's nodal reading is the one the core gives to the eigenstates, phonon modes and orbitals of every driven density field; Table 1's kagome localization length of 6.2 Å beside twisted $MoTe_2$'s 52 Å at comparable ratios of interaction to width is the record's comparison of two flat bands of different construction; 0.3a's repetition at every size belongs to the support of α, and no ratio of a material's energy scales is read from it.

7 System-level reading (exploratory)

Scope: this section re-describes the record's own nearest-neighbour model; every number in it is an in-sample re-description, and its X-labelled observable is never counted with the predictions.

X-1: the line-graph constraint of the flat band. Observable: the amplitudes of a flat-band state on the three corners of one kagome triangle, in the nearest-neighbour model that the record's tight-binding fit extends (L1267–L1270). Defining condition: with Y the incidence matrix of sites and triangles (every site on two triangles, every triangle on three sites), $\triangle$ one triangle and $i \in \triangle$ its sites, I the identity, $\mathsf{t}_{\mathrm{nn}} > 0$ the nearest-neighbour hopping energy, ψ_i the amplitude on site i and H_{nn} the nearest-neighbour Hamiltonian, the adjacency of the kagome net is $\mathsf{Y}\mathsf{Y}^{\mathsf{T}} - 2\mathsf{I}$, so that

$$H_{\mathrm{nn}} = -\mathsf{t}_{\mathrm{nn}}\big(\mathsf{Y}\mathsf{Y}^{\mathsf{T}} - 2\mathsf{I}\big),$$
$$H_{\mathrm{nn}}\psi = 2\mathsf{t}_{\mathrm{nn}}\psi \;\text{ exactly when }\; \mathsf{Y}^{\mathsf{T}}\psi = 0, \;\text{ that is, }\; \sum_{i\in\triangle}\psi_i = 0 \;\text{ on every triangle.} \tag{16}$$

Derivation: $(\mathsf{Y}\mathsf{Y}^{\mathsf{T}})_{ij}$ counts the triangles holding both i and j, which is 1 for neighbours and 2 on the diagonal; $\mathsf{Y}\mathsf{Y}^{\mathsf{T}}$ is positive semidefinite, so $2\mathfrak{t}_{\mathrm{nn}}$ is the top of the spectrum and its eigenspace is the kernel of Y^{T} — the record's topmost quasiflat band (L766) in the ideal model. The per-triangle relative constraint's plane holds the integer set $\{\boldsymbol{\eta} \in \mathbb{Z}^3 : \eta_1+\eta_2+\eta_3 = 0\}$; with the common mode removed, the basis $\mathbf{b}_1 = \mathbf{y}_1 - \mathbf{y}_2$, $\mathbf{b}_2 = \mathbf{y}_2 - \mathbf{y}_3$ ($\mathbf{y}_k$ the unit vectors of $\mathbb{Z}^3$, and $\mathbb{Z}_3$ the cyclic group of order three) has the Gram matrix $(\mathbf{b}_k \cdot \mathbf{b}_l)$ of its two vectors that I-5a writes for $K_{\cap}$:

$$\left(\mathbf{b}_k \cdot \mathbf{b}_l\right) = \begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix}, \qquad \det = 3, \qquad \text{discriminant group } \mathbb{Z}_3. \tag{17}$$

Comparator: the honeycomb's two-site bond constraint $\eta_1+\eta_2 = 0$ gives the one-dimensional lattice of Gram matrix (2), determinant 2 and discriminant $\mathbb{Z}_2$: the three of Eq. (17) is the corner count of the triangle, a structural parallel.

Guards. The I-5a seat lattice and the kagome band are never identified, and no map between them is used; O-10's four premises are untouched by X-1. The record's 1/3 (L1104), I-5a's 2/3 and I-1a's 2/3, the threshold of the overlap-contrast application A-3, are never identified, nor is the parallel's $\mathbb{Z}_3$ identified with the record's threefold degeneracy, which the observation map reads as Laughlin $K = (3)$, rank 1, against the rank-2 form here.

8 Convergence statement

The limiting map. For the same source and data FDT returns the record's numbers unchanged. Every measured quantity — the flat-band bounds (L773–L774), the monolayer's position below the Fermi level (L932), the gating span (L1050), the insulator-to-metal transition (L1064–L1065), the twist angles (L791), the one-layer step (L708) — is accepted in full and read, never altered. The record's kagome Coulomb estimate, its two per-cell counts and its capacitor density are returned by the record's own formula on the record's own inputs, the identity map of Use item 2: $\mathfrak{U}_{\mathrm{C}} = 460$ meV at $\mathfrak{a}_{\mathrm{loc}} = 6.2$ Å and the exact diagonalization's $\varepsilon_{\mathrm{r}} = 5$, Table 1 printing none (L729–L731, L1309); $\mathfrak{n} = 1/\mathfrak{a}_{\mathrm{cell}}^2$ for both per-cell counts (L924–L935); and the capacitor model's -1.5×10^{13} cm^{-2} at the axis end of Fig. 4e (L845, L1283–L1293). Table 1's moiré Coulomb column (L731) is ref. 42's (L742–L744) and is carried as printed, the record stating no ε_{r} for it (SA-32), and the abstract's "220-fold" (L37) is carried as the abstract's figure, no record line deriving it (SA-03). Every calculation is carried as calculated and every fit as fitted, in-sample where the record set it against the same spectra (SA-95, SA-106, SA-120, SA-121). In the gravitational window the nuclei and the flake read laboratory-small compactness on A-1, and for the same stress tensor and data FDT and GR solve the same $G_{\mu\nu} = \kappa T_{\mu\nu}$ (I-3 containment); the record's quantum geometry is band geometry over crystal momentum and enters no curvature slot. Divergence enters only where a core clause supplies a changed observable dictionary or a constitutive input, in T-1 to T-5 and T-7.

Declined readings. The standard account reads the flat band's "destructive interference of electron" hopping (L930–L931; SA-57) as the cancellation of probability amplitudes on a frustrated lattice. FDT reads it as the cancellation of projected helical phases that the clamp net locks around each hexagon, deterministic (I-4); the band, its bounds and its isolation are accepted in full.

The record's introduction counts "long-range entanglement" in real space among kagome phenomena (L47–L48; SA-05), the standard reading of correlation between separated parts of a lattice. FDT reads such correlation as a shared bivector grade, deterministic (I-4); the record measures no entanglement, and its spectra are accepted in full.

The record names ε_0 "the vacuum" permittivity (L1290–L1291; SA-100), the standard reading of ε_0 as a constant of an empty background. FDT reads ε_0 and μ_0 as response coefficients of the omnium, so c^2 is a medium property (0.1); the capacitances and every Coulomb energy built on ε_0 (L731, L1536) are accepted in full.

The standard account reads the record's "Dirac fermions" (L45), "Dirac electrons" (L781), "flat-band electrons" (L905) and "hole carriers" (L1048) as distinct particles with intrinsic properties (SA-04). FDT reads the Dirac fermions, the Dirac electrons and the flat-band electrons as braid configurations of one excitation, $n = 3$ closures in the modes of their crystals' confinements, the kagome net's, the graphene's and the graphite's, and the hole carriers as modes of the flat band those closures leave empty, never a closure of their own, with no intrinsic particle masses or properties (I-5); the dispersions are accepted in full.

The standard account reads the four-terminal reciprocity T-1 uses, the Onsager–Casimir relation, as a consequence of microscopic reversibility, a process and its reverse read as mirror events. FDT reads each step as the system-wide, many-to-many settlement of the state it starts from, and events do not commute (0.1a, I-5b); the reciprocity is measured on each device, and every measured resistance is accepted in full.

9 Status ledger

Every owed item the manuscript touches, in the core's words, every held-out target, every prediction, every in-sample reading and every token, once:

item	statement	status
O-1	"the finite-core cutoff r_c, the regular core chart, or the outward phase-transfer law"; touched by the interior domain of Eq. (4)	owed (O-1)
O-2	"a geometrically constructed odds for the overlap-contrast application (A-3)"; touched by α_{ovl} and by the retired DC-6	owed (O-2)
O-3	"a canonical odds for the confinement application (A-4)"; touched by α_{conf} and the cone-position axis	owed (O-3)
O-4	"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"; touched by the interior charts of the clamp nuclei	owed (O-4)

item, continued	statement	status
O-5	"how P-4's many-cone settlement signs a pair it does not join"; touched by the retired DC-7	owed (O-5)
O-6	"the maps from a charge, a circulating charge or a colour seat to an I-1 input"; touched by the Coulomb scale and by the twist's moments	owed (O-6)
O-9	"the confinement operator D, its domains, boundary data and spectrum; every mass ratio, including the two held-out targets"; touched by Eq. (8), by the isotope masses of T-3 to T-5 and by their clamp term read as I-5's boundary data	owed (O-9)
O-10	"the four premises of the seat lattice; the $U(1)$ embedding and unit"; touched by the $K = (3)$ reading and the exploratory guards	owed (O-10)

item, continued	statement	status
held-out targets	the two mass ratios of I-5, the proton's to the electron's and the muon's to the electron's squared, carried as tests; neither is read here	held-out
T-1	hand-locked zero-field anomalous Hall sign of twisted bilayers (DC-1, SA-10); convergence value: no sign locked to the hand in every device	prospective; conditional by construction at B_{set}, on the cooling's share of the sign vanishing at the slower rate
T-2	torsion-odd stray field over a pristine ribbon (DC-2, SA-74); convergence value: $B_{\mathrm{odd}} = 0$	prospective; conditional by construction, on no heat flow along the ribbon and a clamp background the cut leaves unchanged
T-3	sign of the Pd-isotope shift of E_{FD} (DC-3, SA-25); convergence value: the sign s_{ZP}	prospective; conditional by construction, on the lots' share within the bound the comparator's calculation sets
T-4	sign of the Rb-isotope shift of E_{FD} (DC-4, SA-53); convergence value: the sign s_{ZP}	prospective; conditional by construction, on the lots' share within the bound the comparator's calculation sets

item, continued	statement	status
T-5	sign of the S-isotope shift of E_{opt} (DC-5, SA-19); convergence value: the sign s_{ZP}	prospective; conditional by construction, on the lots' share within the bound the comparator's calculation sets
T-7	mirror-odd zero-field Kerr rotation of twisted heterotrilayers (DC-8, SA-47); convergence value: $\Phi_{\mathrm{odd}} = 0$ at zero power	prospective; conditional by construction, on a light-borne moment linear or quadratic in the power and no heat flow through the stack
DC-6	onset filling of the correlated insulator against the A-3 threshold (SA-69)	retired, NO-MAP (O-2)
DC-7	bond-resolved spin correlations of a kagome triangle read through P-4 (SA-66); the one-axis map admits no non-collinear triangle	retired, NO-MAP (O-5)
twist magnitudes	"Quantitative twist → moment forms are derived in-manuscript through I-1/I-2 with a declared kernel": none is derived here	T-1, T-2, T-7 carry signs only
isotope sensitivities	"stays conditional until the sensitivities are established" (I-7 discipline 2): no S_{dens}, S_{geo}, S_{ZP} or S_{clamp} is established here	T-3, T-4, T-5 carry signs only
in-sample	the record's HF fraction and renormalization factor (L1314–L1317), its DFT path (L1564), its tight-binding fit (L1268, L1578); the exploratory section's re-descriptions	in-sample, never counted
tokens	α_{ovl} (A-3), α_{conf} (A-4), α_{mode} (A-5): each a token with its range and nothing else	PROVISIONAL

10 Conclusions

The record of Bong *et al.* [1] supplies measured exhibits of FDT's core clauses — nodal localisation in a clamp net (P-2, P-3), confinement cost (I-5), one settlement (0.1a), one carrier (I-2) and one density ledger (I-7) — and its other measurements are accepted in full; its quoted interference mechanism takes the reading of locked helical phases (I-4), and its calculated one-third state the manuscript's Laughlin reading through I-5a's fractional accounting, the strand ledger integral. The convergence statement accepts every measured number of the record in full, returns its kagome Coulomb estimate, per-cell counts and capacitor density on the record's own inputs, carries its remaining estimates as printed, Table 1's moiré column among them as ref. 42's, and declines five

readings. Six predictions stand where FDT supplies what the consensus calculation lacks: three twist blocks of P-5 (T-1, T-2, T-7) and three isotope blocks of I-7 (T-3, T-4, T-5), each a sign or existence prediction with a stated design, an executed decision, an outcome that contradicts it and a live ablation, the isotope blocks' at the test point of a positive, dominating density sensitivity and a negative consensus zero-point sign; two candidates are retired for want of a map (O-2, O-5). FDT is a true extension of general relativity and quantum mechanics, and it accepts every measurement of this record as measured.

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