**Quantum Entropy Field Theory (QEFT)**

**1) Degrees of freedom & symmetries**

* Promote the entropy field to a quantum field. For helical/filament phases, use a complex order parameter  
  \Phi(x)=\rho(x)\,e^{i\varphi(x)} (amplitude–phase), which reduces to your scalar S or E in the appropriate gauge/limit.
* Introduce a timelike “aether/orientation” vector u^\mu (comoving 4‑velocity of the thermal bath) and an optional spacelike filament director n^\mu (emergent large‑scale orientation). These give a covariant way to encode your angular bias term.

**2) Closed‑system (Hermitian) core**

\boxed{ \mathcal{L}\_{\rm QEFT} = \frac{1}{2\kappa}R • g^{\mu\nu}\partial\_\mu\Phi^\ast\partial\_\nu\Phi • V(|\Phi|) • \frac{\xi}{\Lambda}\, n\_\mu\,J\_\Phi^\mu • \frac{\lambda\_{\rm EM}}{4\Lambda}\,S\,F\_{\mu\nu}\tilde F^{\mu\nu} • \frac{\lambda\_{g}}{\Lambda}\,S\,R\_{\mu\nu\rho\sigma}\tilde R^{\mu\nu\rho\sigma} }

* J\_\Phi^\mu \equiv i(\Phi^\ast \partial^\mu \Phi - \Phi \partial^\mu \Phi^\ast) (U(1) current of \Phi).
* S \equiv f(|\Phi|) is the entropy scalar (e.g., S\!\propto\!\rho or a monotone of |\Phi|^2).
* The parity‑odd n\_\mu J\_\Phi^\mu term seeds helical/filament orientation (covariant analogue of your \varepsilon\sin(n\theta)E).
* S\,F\tilde F and S\,R\tilde R are emergent birefringence/parity couplings (axion‑like in form but with S = entropy field, not a new particle). Set \lambda’s to zero if you prefer a minimal model.

Equations of motion (closed system)

\square\Phi + V’(|\Phi|)\,\Phi/|\Phi| + \dfrac{\xi}{\Lambda}\,n\_\mu\,\partial^\mu\Phi + \cdots = 0

Einstein: G\_{\mu\nu}=\kappa\,(T^{\Phi}{\mu\nu}+T^{\rm matter}{\mu\nu}) with

T^{\Phi}{\mu\nu}=\partial\mu\Phi^\ast\partial\_\nu\Phi+\partial\_\nu\Phi^\ast\partial\_\mu\Phi - g\_{\mu\nu}\big(|\partial\Phi|^2 - V\big)+\cdots.

Remark. With spatially uniform u^\mu and slowly varying n^\mu, the ground‑state solutions are chiral/helical textures of \varphi, giving double‑helix filaments consistent with your topology claims.

**3) Open‑system (finite‑temperature) completion**

To recover diffusion + logistic growth, couple \Phi to a thermal environment and integrate it out via Schwinger–Keldysh (or write the equivalent Lindblad master equation):

\dot\rho = -\frac{i}{\hbar}[H\_{\rm QEFT},\rho] • \sum\_a \gamma\_a(T)\Big(L\_a\,\rho\,L\_a^\dagger - \tfrac{1}{2}\{L\_a^\dagger L\_a,\rho\}\Big),

Choose jump operators (minimal choice):

* L\_{\rm diff}=\int d^3x\ \sqrt{\alpha(T)}\,\nabla\Phi(x) \Rightarrow spatial diffusion term,
* L\_{\rm react}=\int d^3x\ \sqrt{\beta}\,\Phi(x)\,[1-|\Phi(x)|^2] \Rightarrow logistic self‑interaction,
* L\_{\rm chiral}=\int d^3x\ \sqrt{\varepsilon}\,\sin(n\theta)\,\Phi(x) \Rightarrow angular bias.

**4) Semiclassical / hydrodynamic limit (how your PDE reappears)**

Take expectation values in coherent states and gradient‑expand the Keldysh action (or use Truncated‑Wigner). For E \equiv \langle S \rangle (or E\!\propto\!\langle|\Phi|^2\rangle):

\boxed{ \frac{\partial E}{\partial t} = \alpha(T)\,\nabla^2 E • \beta\,E(1-E^2) • \varepsilon\,\sin(n\theta)\,E \quad\text{(+ noise)}}

* This is your PDE (diffusion + logistic + angular bias), now derived as the open‑quantum, semiclassical limit of QEFT. Temperature scaling T\!\propto\!(1+z) feeds \alpha(T), giving your H(z)=H\_0(1+z)^{-\gamma} with \gamma=\delta-1 and optional \gamma(z)=\gamma\_0+\gamma\_1\ln(1+z).

**5) Cosmological sector (observables)**

* Modified Friedmann: H^2=\frac{\kappa}{3}\big(\rho\_{\rm SM}+\rho\_\Phi^{\rm eff}\big), with \rho\_\Phi^{\rm eff} from T^{\Phi}\_{\mu\nu} plus dissipative corrections (expectation values in \rho).
* Distances: D\_L,\ \mu(z) as in your pipeline; the same H(z) drops in.
* Birefringence/parity: nonzero \langle S\rangle or \partial\_\mu S sources EB rotation via S\,F\tilde F (and potentially gravitational‑CS via S\,R\tilde R).
* Lensing proxy: \kappa(\mathbf{x}) \propto \nabla^2 \langle S\rangle or \nabla^2 \langle|\Phi|^2\rangle, matching your entropy‑curvature mapping.

**6) Parameter dictionary (to report in Methods)**

\alpha(T)\ \leftrightarrow\ \gamma\_{\rm diff}(T)\quad \beta\ \leftrightarrow\ \gamma\_{\rm react},\quad \varepsilon\ \leftrightarrow\ \gamma\_{\rm chiral},\quad \text{all } \gamma\_a \text{ from system–bath couplings.}

Report (\xi/\Lambda,\lambda\_{\rm EM}/\Lambda,\lambda\_g/\Lambda) with priors/constraints; set them to zero for a conservative minimal model.