Seraphic Calibration Shell for Q⊗DASH (Metatron VM)
A Meta-Model for Fixpoint-Directed Quantum-Hybrid Optimization

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Abstract

This document introduces the *Seraphic Calibration Shell* (SCS), a meta-model that surrounds the Q⊗DASH (Metatron VM) quantum-hybrid backend with a field-theoretic feedback and contraction layer. The goal of the SCS is to enforce a dynamics in which every admissible update of algorithmic configurations (e.g. VQE, QAOA, walks, Grover, Boson sampling, VQC/QML) moves the system monotonically towards a fixpoint attractor in configuration space. The construction combines three existing conceptual components: (i) seraphic feedback modules that encode benchmark results into a field-level resonance signal, (ii) a field-theoretic contraction operator of FSM-type acting as a double-kick on configurations, and (iii) a CRI-like resonance impulse that allows controlled phase transitions between distinct attractors when necessary.

1 Conceptual Context

The Q⊗DASH (Metatron VM) core exposes a family of quantum-hybrid algorithms and operators (VQE, QAOA, quantum walks, Grover search, Boson sampling, VQC/QML, resonance- and path-invariance operators). Each concrete setting of hyperparameters, ansatz choices and optimizer options will be called a *configuration*.

The Seraphic Calibration Shell (SCS) is a meta-layer that does not replace these algorithms; instead, it controls how configurations are evaluated, updated and accepted. Intuitively, the SCS acts like a field-theoretic *pressure* that pushes the entire system towards one or several fixpoint attractors, such that:

- either the system remains in a stable configuration, or
- if it moves at all, every movement is directed towards a well-defined fixpoint attractor.

To describe this behaviour, the SCS introduces:

1. a triadic state representation (ψ, ρ, ω) for configurations, capturing quality, stability and efficiency;
2. seraphic feedback modules that encode benchmark outcomes into a dynamical field (Mandorla-like) $M(t)$;
3. a field-theoretic, locally contractive double-kick operator $T = \Phi_V \circ \Phi_U$ acting on configurations; and
4. a CRI-style resonance impulse that triggers controlled regime changes when the current attractor becomes globally unfavourable.

2 Configuration State and Performance Triplet

Let $\mathcal{C}$ denote the space of all admissible configurations of Q⊗DASH. A configuration $c \in \mathcal{C}$ may include, for example, ansatz depths, optimizer types, learning rates, dephasing parameters, shot counts, and similar hyperparameters.

Definition 2.1 (Benchmark outcome)**.** For a given configuration $c \in \mathcal{C}$, let $u(c) \in \mathbb{R}^n$ denote the vector of benchmark metrics obtained by running the full CI-benchmark suite of Q⊗DASH with configuration c. This vector may include, among others:

- ground-state energy errors for VQE instances;
- approximation ratios for QAOA;
- speedup factors and mixing diagnostics for quantum walks;
- success probabilities and iteration counts for Grover;
- visibility and throughput for Boson sampling;
- accuracy and convergence indicators for VQC/QML.

Definition 2.2 (Performance triplet)**.** For each configuration $c \in \mathcal{C}$, the SCS associates a *performance triplet*

$$\Phi(c) = (\psi(c), \rho(c), \omega(c)) \in [0,1]^3,$$

where:

- $\psi(c)$ (*semantic quality*) is a normalized measure of how good the configuration is across all relevant tasks (e.g. inverted relative energy errors, approximation ratios, success probabilities);
- $\rho(c)$ (*stability / path invariance*) encodes the robustness of these metrics under variations of seeds, noise, and problem instances (low variance $\Rightarrow$ high ρ);
- $\omega(c)$ (*phase readiness / efficiency*) captures the efficiency of the configuration, e.g. via normalized inverse runtimes, evaluations per second and resource usage.

All three components are scaled to $[0, 1]$.

Intuitively, ψ measures *how well* the configuration performs, ρ measures *how reliably* it behaves, and ω measures *how economically* it operates.

3 Seraphic Feedback and Field Embedding

At each calibration step $t \in \mathbb{N}$, the CI-pipeline of Q⊗DASH produces a benchmark vector u_t for the currently active configuration c_t. The Seraphic Calibration Shell uses a seraphic feedback module (SFM) to embed these numerical outcomes into a field-level signal.

Definition 3.1 (Seraphic feedback encoder)**.** The seraphic feedback encoder is a (possibly nonlinear) map

$$g_{\mathrm{SFM}} : \mathbb{R}^n \to \mathbb{R}^m,$$

which produces an *internal feedback vector* $I_t = g_{\mathrm{SFM}}(u_t)$. This I_t is interpreted as an injection into a dynamical field $M(t) \in \mathbb{R}^m$, the *Mandorla-like calibration field* of Q⊗DASH.

A simple update rule for the field is

$$M(t+1) = \mathrm{Norm}\Big(\alpha\, M(t) + \sum_i \beta_i\, G_i(t) + \gamma\, I_t\Big), \tag{1}$$

where:

- $G_i(t)$ denote contributions from internal resonant submodules (e.g. different ansatz families or operator clusters),
- $\alpha, \beta_i, \gamma \geq 0$ are weighting coefficients, and
- $\mathrm{Norm}(\cdot)$ projects back onto a suitable bounded domain.

Equation (1) means that each benchmark cycle leaves a trace in the field $M(t)$: high-quality, stable and efficient configurations produce characteristic resonance patterns that gradually shape the landscape in which future updates are evaluated.

4 Double-Kick Operator on Configuration Space

To realize the "screw tightening" behaviour, the SCS introduces a double-kick operator T on configuration space that is intended to be locally contractive around desirable attractors.

Definition 4.1 (Update and stabilisation kicks)**.** Let Φ_U and Φ_V be two maps $\mathcal{C} \to \mathcal{C}$:

- Φ_U is an *update kick* that modifies c along an ascent direction of ψ, i.e. it attempts to increase semantic quality:
$$\Phi_U(c) = c + \eta_U \, \nabla_c \psi(c)$$
for a suitable step size $\eta_U > 0$ and generalized gradient $\nabla_c \psi(c)$ in configuration space;
- Φ_V is a *stabilisation kick* that adjusts c primarily along directions that improve $\rho(c)$ and $\omega(c)$ without significantly degrading $\psi(c)$, for example by regularising hyperparameters or enabling robustness mechanisms:
$$\Phi_V(c) = c + \eta_V \, R(c),$$
where $R(c)$ is a vector field pointing towards higher stability and efficiency, and $\eta_V > 0$ is a step size.

Definition 4.2 (Double-kick operator)**.** The *Seraphic double-kick operator* T on configuration space is defined as
$$T = \Phi_V \circ \Phi_U : \mathcal{C} \to \mathcal{C}.$$

Definition 4.3 (Local contraction region)**.** A subset $D \subset \mathcal{C}$ is called a *local contraction region* of T if there exists a constant $L \in (0, 1)$ such that
$$\|T(c_1) - T(c_2)\| \leq L \, \|c_1 - c_2\| \quad \text{for all } c_1, c_2 \in D,$$
with respect to a suitable norm $\| \cdot \|$ on configuration space.

Proposition 4.4 (Existence of a configuration fixpoint)**.** *If $D \subset \mathcal{C}$ is a non-empty, closed subset and a local contraction region of T, then there exists a unique configuration $c^* \in D$ such that $T(c^*) = c^*$. Moreover, for any starting point $c_0 \in D$, the iterates $c_{t+1} = T(c_t)$ converge to c^* as $t \to \infty$.*

Proof. Immediate consequence of the Banach fixed point theorem. □

In the language of the original field-theoretic model, such a configuration fixpoint c^* corresponds to a *Temporal Information Crystal* (TIC): a configuration that is invariant under the double-kick dynamics and attractive for all sufficiently nearby configurations.

5 Proof-of-Resonance and Configuration Acceptance

Not every output of T is immediately accepted as the new operational configuration of Q$\otimes$DASH. The SCS introduces a *Proof-of-Resonance* (PoR) criterion to decide when a candidate configuration c' is allowed to replace the currently active one.

Definition 5.1 (Proof-of-Resonance (PoR))**.** Let c be the current configuration and $c' = T(c)$ a candidate configuration. Let $u(c)$ and $u(c')$ denote the corresponding benchmark vectors, and let $\Phi(c) = (\psi(c), \rho(c), \omega(c))$ and $\Phi(c') = (\psi(c'), \rho(c'), \omega(c'))$ be their performance triplets.

We say that c' passes the *Proof-of-Resonance* test if:

(i) *Non-decrease of quality:* $\psi(c') \geq \psi(c)$;

(ii) *Stability-consistency:* $\rho(c')$ is not significantly smaller than $\rho(c)$ (within a tolerance band);

(iii) *Efficiency-consistency:* $\omega(c')$ does not fall below a prescribed minimum; and

(iv) *Field-level resonance:* the field $M(t)$ exhibits a positive correlation between its current state and the seraphic injection I_t associated with $u(c')$.

Only if PoR is satisfied is c' accepted as the new active configuration. Otherwise, the candidate is rejected (or stored as a speculative mutation), and the system continues from c with new benchmark evaluations.

6 CRI-Style Resonance Impulses

The preceding sections describe a locally contractive evolution towards a single attractor. However, it may be desirable to allow *controlled* transitions between qualitatively different attractors when the global calibration landscape changes.

To this end, the SCS introduces a CRI-like resonance impulse.

Definition 6.1 (Global calibration functional)**.** Let $J(t)$ be a scalar functional summarising the global state of the system at calibration step t, for example

$$J(t) = \psi_{\text{avg}}(t) \cdot \rho_{\text{avg}}(t) \cdot \omega_{\text{avg}}(t),$$

where the averages are taken over a suitable ensemble of recent configurations and benchmarks.

Definition 6.2 (Resonance impulse trigger)**.** If $J(t)$ stagnates or degrades over a prescribed number of calibration steps, and, at the same time, the field $M(t)$ indicates a strong resonance with an alternative configuration manifold (e.g. another ansatz family or embedding regime), then a *resonance impulse* is triggered: parameters controlling the family of admissible configurations (such as ansatz topology, optimizer class or encoding strategy) are modified by an operator $\mathcal{R}$, initiating a controlled phase transition into a new contraction region $D' \subset \mathcal{C}$.

This CRI-like mechanism ensures that the system does not remain forever trapped in a locally optimal but globally suboptimal attractor: while within a contraction region the dynamics is fixpoint-oriented and tightening, the overall meta-dynamics can switch to a different region if the global resonance pattern demands it.

7 Meta-Algorithm for Seraphic Calibration

Putting the components together, the Seraphic Calibration Shell for Q$\otimes$DASH can be summarized as the following iterative process:

1. **Benchmark:** Run the full CI-benchmark suite with the current configuration c_t, obtain u_t and compute $\Phi(c_t)$.

2. **Seraphic feedback:** Encode u_t via $I_t = g_{\mathrm{SFM}}(u_t)$ and update the field $M(t)$ according to (1).

3. **Double-kick update:** Compute the candidate configuration $c_t' = T(c_t)$ via the update and stabilisation kicks Φ_U and Φ_V.

4. **Proof-of-Resonance:** Benchmark c_t', obtain u_t' and $\Phi(c_t')$. If c_t' passes the PoR test, accept it as $c_{t+1} = c_t'$; otherwise set $c_{t+1} = c_t$.

5. **CRI-check:** Update the global functional $J(t)$. If $J(t)$ indicates persistent stagnation or degradation and the field $M(t)$ resonates with an alternative regime, apply the resonance impulse operator $\mathcal{R}$ to shift the admissible configuration family and re-initialize c_{t+1} within the new contraction region.

By design, this loop implements the intended semantics: either the system remains in a stable “information crystal” configuration, or—if it moves—every accepted movement is constrained to move towards a fixpoint attractor, while CRI-style resonance impulses provide the freedom to transition between different attractors when the global field intelligence demands it.