VCF Research – Updated Engine Architecture & Phase Plan
Engine Naming (Final Architecture)
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Regime_Engine # Phase I — Economic Regime Engine
Sector_Regime_Engine # Phase II — Sector Regime Engine
Unified_Engine # Phase III — Combined Macro + Sector Geometry
Wavelit_Engine # Phase IV — Wavelet + Resonance Regime Engine
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Phase I — Regime_Engine (Economic Regime Engine)
Purpose
Identify leading, confirming, and lagging economic indicators. Build economic geometry and economic cycle regimes.
Core Math
- Z-score normalization
- Macro pillar M(t)
- Liquidity pillar L(t)
- Economic geometry:
- θ = atan2(M, L)
- Cθ = sqrt($M^2 + L^2$)
- Economic regime mapping (contraction $\rightarrow$ expansion $\rightarrow$ overheating)
Output
Economic regime time series + geometric coordinates.

Phase II — Sector_Regime_Engine (Sector Regime Engine)
Purpose
Model sector interactions, sector leadership, lagging, synchrony, divergence, harmonic signatures, and sector-cycle structure.
Novel contribution: _formalized Sector Regime theory._
Core Math
- Sector normalization (SPY, sectors, VIX)
- Sector pillar E(t)
- Sector-risk geometry:
- ϕ = atan2(E, R)
- Cϕ = sqrt($E^2 + R^2$)
- Sector dispersion (std of sector z-scores)
- Sector breadth (% of sectors > 0)
- Harmonic structure:
- Short-cycle power
- Long-cycle power
- Harmonic ratio
- Dominant period
Output
Sector regime identification + harmonic cycle diagnostics.

Phase III — Unified_Engine (Unified State Space Engine)
Purpose
Combine macro + sector + harmonic metrics into a unified state vector.
Derive low-dimensional VCF Geometry: Θ_VCF, Φ_VCF, R_VCF.
Core Math
- Unified feature vector X(t)
- PCA $\rightarrow$ 3D coordinates Y1, Y2, Y3
- Unified geometry angles:

- Θ_VCF = atan2(Y2, Y1)
- Φ_VCF = atan2(Y3, Y1)
- R_VCF = sqrt($Y1^2 + Y2^2 + Y3^2$)

Output
Unified VCF geometry (full system state).

Phase IV — Wavelit_Engine (Wavelet + Regime Engine)

Purpose
Wavelet decomposition, multi-scale cycle detection, macro–market resonance, full regime classification.

Core Math
- CWT wavelet transform
- Wavelet power spectrum
- Scale-to-period conversion
- Short vs long wavelet power ratios
- Dominant cycle length
- Phase alignment and resonance:
- Resonance = cos($\Delta\phi$ at dominant macro frequency)

Output
Final VCF regimes + resonance maps + time-frequency cycle atlas.

Summary
This plan represents the official layered architecture for VCF Research.
Each engine builds on the previous one to form a complete, multi-scale, geometric, and wavelet-driven research system.