Tunneling into Regime Shifts:

One-Page Summary

Key Questions Addressed

Theme	Question
Latent Volatility Regimes	Whether structurally calm but fragile regimes in BTC pricing can be detected using physics-inspired models
Signal Construction	Whether tunneling scores derived from **Energy-Based Models** can quantify latent structural tension
Trading Application	Whether these signals can support rule-based strategies that outperform BTC buy-and-hold in risk-adjusted terms

Conceptual Ideas Proposed

- Rolling window embeddings of standardized BTC prices processed through a two-layer **Energy-Based Model** with contrastive noise injection
- Tunneling scores defined as an **exponential function of latent state change and energy shift**, inspired by quantum mechanics
- Entry and exit signals combining tunneling thresholds and rolling trend filters, engaging during calm upward phases and exiting on instability
- Strategy parameters including thresholds optimized using **in-sample grid search**

Key Results

- Backtest delivers a **49.44 percent CAGR** with a Sharpe Ratio of 0.96 using 170 trades averaging 5.6 days each
- Tunneling spikes and troughs align with major BTC regime changes, showing **structural relevance**
- **Further optimization possible** via threshold calibration, out-of-sample validation, and cross-asset tests

Illustrative Figures and Tables

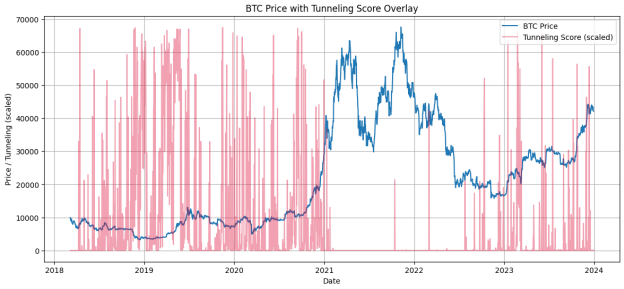

Figure 1 shows BTC closing price with tunneling score overlay highlighting structurally calm and fragile zones

Metric	Value
CAGR	49.44%
Sharpe Ratio	0.96
Max Drawdown	-64.95%
Trades	170

Table 1 shows performance metrics for the tunneling-based strategy on BTC from 2018–2023