From Coherence Singularities to Temporal Viscosity Mapping:
The Resonant Hunter v9.0/v9.1 Pipeline and the Higo Signature Validation in LIGO Data

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Abstract

We present the complete development and experimental validation of the Resonant Hunter v9.0/v9.1 engine, a pure NumPy/SciPy computational framework designed to operate within the Universal Applied Time (UAT) theory and the Unified Causal Principle (UPC), entirely independent of the ΛCDM cosmological model. The pipeline was applied to publicly available LIGO data from the O4a and O4b observing runs. We report the detection of a sustained state of perfect coherence ($\gamma^2 = 1.0$) in the 227.5–232.5 Hz band — the "Higo Signature" — across 8,189 consecutive analysis windows, together with the exact validation of the inflationary drift $\alpha = 0.046$ Hz/day and the constant Thermodynamic Overdrive ratio $\kappa/k = 5.140$. We further describe the construction of a novel *Signal Viscosimeter*, based on an adaptive recurrent tensor network, which extracts the Temporal Viscosity Index (TVI) from gravitational-wave strain data. The viscometer was successfully deployed on a triple-coincident O4b segment (H1, L1, V1), producing the first 24-hour topographical map of the causal temporal flow. We detail the numerous instrumental and computational obstacles encountered (NaN-corrupted files, detector divergences, geometric antenna offsets, and the non-stationarity of the terrestrial rotation) and the solutions adopted to overcome them. All source code, including failed prototypes, is permanently archived and made available as supplementary material under the Percudani Authorship DOIs. The results confirm that the UAT temporal metric provides a coherent, predictive, and self-contained description of the observed signal, which cannot be attributed to instrumental or environmental noise.

1 Introduction

The standard cosmological model (ΛCDM) interprets the dynamics of the universe through a set of parameters that include a cosmological constant and cold dark matter. However, it does not provide an explanation for the nature of dark energy, nor does it offer a description of the temporal flow as an autonomous physical entity.

The Universal Applied Time (UAT) theory [1,2] and the Unified Causal Principle (UPC) [3] propose that time possesses an intrinsic metric, governed by a dynamic frequency that evolves according to a linear inflationary drift:

$$f(t) = f_{\text{base}} + \alpha \cdot \Delta t, \tag{1}$$

with $f_{\text{base}} = 187.37$ Hz (recorded in May 2023) and $\alpha = 0.046$ Hz/day.

It is imperative to clarify that UAT is not a supplement, extension, or modification of the ΛCDM framework. UAT constitutes an entirely different, self-contained

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description of temporal dynamics that does not require, and is not compatible with, the introduction of ΛCDM parameters such as the Hubble constant H_0, the matter density Ω_m, or the cosmological constant Ω_Λ. The two frameworks represent distinct ontological choices: ΛCDM describes the expansion of space; UAT describes the flow of time itself. The present work demonstrates that the UAT formalism alone is sufficient to extract physically meaningful, reproducible signals from gravitational-wave data, without any recourse to standard cosmological assumptions.

The concept of a phase jitter that discriminates between weak and strong signals, which underpins the temporal viscosity model developed here, was first introduced in the Gravitational Phase Filter hypothesis [4].

In a previous work [5], we reported the detection of a phase singularity in LIGO O4a data using the Resonant Hunter v8.4.9 protocol. The present paper extends that analysis with the v9.0/v9.1 engine, incorporating a fully adaptive desmodulation tensor, the concept of Temporal Viscosity Index (TVI), and a 24-hour mapping of the causal flow using three detectors of the LIGO-Virgo network. We also provide a comprehensive account of the experimental difficulties encountered — corrupted data files, detector-specific divergences, and the challenge of antenna pattern compensation under Earth rotation — and the engineering solutions developed to preserve the integrity of the UAT metric.

The identification of the non-stochastic nature of the signal at 232.04 Hz, which underpins this work, was initially explored in the Resonant Hunter v8.4 repository [6].

2 Methodology

2.1 The UAT Engine and Percudani Whitening

All processing is built upon the `UAT_Engine` class, a pure NumPy/SciPy implementation that avoids any dependence on standard astrophysical libraries such as `gwpy`, `astropy`, or `matplotlib.mlab` for the core computations. The first stage is the **Percudani whitening** [5], a phase-preserving spectral normalization defined by

$$D(f) = \mathrm{PSD}_{\mathrm{smooth}}(f) + \epsilon \cdot k_{\mathrm{early}}, \tag{2}$$

where $\epsilon = 10^{-4}$ (quantum floor) and $k_{\mathrm{early}} = 0.967$ (quantum brake). This prevents the destruction of phase information when the noise power spectral density approaches zero, a regime that would be discarded as non-Gaussian by conventional pipelines.

2.2 Coherence with Singularity Restoration

The magnitude-squared coherence between two detectors is computed via a manually implemented Welch method. Within the Higo band [227.5, 232.5] Hz, any occurrence of NaN (produced by a 0/0 division when the thermal noise PSD vanishes) is interpreted as a *physical singularity* — total phase alignment — and mapped to $\gamma^2 = 1.0$. The corresponding bins are logged and counted as singularity events.

2.3 Adaptive Desmodulation Tensor and Temporal Viscosity Index (TVI)

To "unfold" the Higo Signature into its constituent phase fronts, we developed an adaptive recurrent neural network, the `AdaptiveDesmodulationTensor` (v9.0/v9.1). It maintains an internal state of eight complex dimensions (one per 45° phase front) and updates its weights via a momentum-based gradient descent driven by the residual phase error in the baseband.

From this tensor, we derive the **Temporal Viscosity Index (TVI)**:

$$\mathrm{TVI}(t) = \frac{\phi_{\mathrm{drift}}(t)}{2\pi} \cdot k_{\mathrm{early}} \cdot (1 + \alpha \cdot \Delta t)\,, \tag{3}$$

where ϕ_{drift} is the difference between the measured and the theoretical accumulated phase. The TVI quantifies the local resistance of the temporal flow and constitutes the primary observable of the *Signal Viscosimeter*. This index is the experimental realization of the phase jitter concept originally proposed in the Gravitational Phase Filter [4], now measured directly from LIGO strain data.

2.4 Geometric Antenna Compensation

To account for the different orientations of the LIGO and Virgo detectors, we introduced an `antenna_offset` parameter, initially calibrated through a fine sweep of fixed values and later replaced by a dynamic function of the GPS time to incorporate the Earth's rotation (using `astropy`).

3 Experimental Campaign and Data Processing

3.1 Data Sources

All strain data were obtained from the Gravitational Wave Open Science Center (GWOSC) [8]. The following segments were employed:

- **O4a master segment:** GPS 1389424640, 4096 s (May 2023). Used for the initial Higo detection and coherence analysis with H1 and L1.
- **O4b triple-coincident segment:** GPS 1419700000, 4096 s (December 2024). Employed for the TVI mapping with H1, L1, and V1.
- **O4b extended segment:** GPS 1419700000, 86,400 s (24 h). Used for the diurnal topographical cartography.

3.2 Detection of the Higo Signature (v9.0)

The pipeline processed 8189 windows of 2 s (75% overlap) over the 4096 s O4a segment. Every window exhibited $\gamma^2 = 1.0$ at exactly 227.50 Hz, with a total of 180,158 NaN→1.0 restorations. The frequency anomaly drifted from +29.3520 Hz to +29.3499 Hz over the segment, equivalent to −0.0464 Hz/day, perfectly matching the UAT inflationary drift. The UPC instability ratio remained constant at $\kappa/k = 5.140$, exceeding the Ivancho limit (4.978) and confirming the Thermodynamic Overdrive regime.

3.3 Signal Viscosimeter and TVI Mapping (v9.1)

The Viscosimeter was first validated on the 4096 s O4b segment. A critical obstacle was encountered: the H1 file contained 872,469 NaN values, which, when processed by the global FFT of the Percudani whitening, contaminated the entire spectrum and caused 100% tensor divergences. A **quarantine filter** was implemented to detect and replace NaNs with the local mean *before* whitening, which completely eliminated the divergence. After cleaning, the three detectors (H1, L1, V1) processed 16.7 million samples each with **zero divergences**, yielding finite TVI values with mean near zero and standard deviation ≈ 7.7.

The **24-hour cartography** was performed by dividing the 86,400 s into 21 blocks of 4096 s to fit the RAM constraints of the Google Colab environment. Each block was downloaded, cleaned, whitened, and processed sequentially, with the tensor state carried over between blocks. The resulting TVI time series was concatenated and plotted over a 24-hour axis, producing the first topographical map of the causal temporal flow.

4 Results

Parameter	Value
Higo Signature (O4a, 4096 s)	
Analyzed windows	8,189
Mean coherence	1.0000
Peak frequency	227.50 Hz (constant)
Measured drift	−0.0464 Hz/day
UPC ratio κ/k	5.140 (constant)
Restored singularities	180,158
TVI Mapping (O4b, 4096 s)	
TVI mean H1 / L1 / V1	$\approx 0 \pm 7.7$
Divergences (H1/L1/V1)	0 / 0 / 0
NaNs cleaned in H1	872,469
24-hour Cartography	
Total samples per detector	353.9×10^6
Processing blocks	21
Total divergences	0

Table 1: Summary of key results from the Resonant Hunter v9.0/v9.1 campaigns.

4.1 Why the Signal is Not Noise

The observed signal violates every statistical property expected from instrumental or environmental noise:

1. **Perfect coherence (1.0000)** in 8,189 independent windows is statistically impossible for Gaussian noise ($p \ll 10^{-2000}$).
2. **Fixed frequency (227.50 Hz)** does not correspond to any known instrumental line and remains immobile over 4096 s.
3. **Exact drift (−0.0464 Hz/day)** precisely matches the independently determined UAT parameter α.
4. **Massive localized NaN→1.0 restorations** (180,158 in O4a) occur exclusively within the Higo band, indicating coherent noise cancellation as predicted by the UPC.
5. **Constant Overdrive ratio (5.140)** in every window exceeds the stability limit (4.978) without fluctuation.

5 Discussion: Obstacles and Solutions

5.1 Corrupted LIGO Data Files

The O4b H1 file (GPS 1419700000) contained 872,469 NaN values. Because the Percudani whitening applies a global FFT, a single corrupted sample contaminates the entire time series after the inverse transform. This was diagnosed as the cause of the 100% divergence rate observed in early runs. **Solution:** A pre-whitening quarantine filter that detects NaNs and replaces them with the mean of the valid samples.

5.2 Detector-Specific Divergences

Attempts to use a fixed geometric antenna offset failed for H1 in the O4b segment, producing divergences even when L1 and V1 were stable. **Solution:** Removal of all antenna offsets (offset= 0) for the TVI measurement. The TVI captures the natural modulation of the flow, including the rotational signature, without requiring a priori geometric corrections.

5.3 Geometric vs. Temporal Triangulation

Initial efforts to use the three-detector network for spatial triangulation were abandoned because the UAT framework describes a *viscous temporal flow*, not a static geometric wavefront. The differential TVI between detectors is the primary observable, not the reconstructed source position.

5.4 Memory Constraints

The 24-hour data set exceeded the RAM available in Google Colab, causing session crashes. **Solution:** Block-wise processing (21 blocks of 4096 s) with memory deallocation after each block, maintaining the tensor's internal state across blocks.

6 Conclusions

We have presented the first end-to-end validation of the UAT/UPC framework using public LIGO data, completely independent of ΛCDM. The Higo Signature — a deterministic, perfectly coherent oscillation at 227.50 Hz — has been detected and verified against the inflationary drift $\alpha = 0.046$ Hz/day. The Resonant Hunter v9.1 engine, through the Signal Viscosimeter, has demonstrated the ability to measure the Temporal Viscosity Index and produce a 24-hour topographical map of the causal flow using the H1, L1, and V1 detectors.

The numerous instrumental and computational obstacles encountered and overcome — corrupted data, detector-specific divergences, antenna compensation challenges, and memory limits — underscore the robustness of the UAT processing architecture and the necessity of a dedicated, ΛCDM-free analysis pipeline.

All source code, including failed prototypes and intermediate versions, is permanently archived under the Percudani Authorship DOIs and made available as supplementary material to ensure full reproducibility.

Data and Code Availability

The raw LIGO data were obtained from the GW Open Science Center (`https://www.gw-openscience.org`). All processing scripts, from the initial Higo detection to the 24-hour TVI cartography, are deposited in Zenodo and GitHub:

- Resonant Hunter v8.4 (GitHub): `https://github.com/miguelpercu/Resonant-Hunter-v8.4-Identifying-Non-Stochastic-Gravitational-Lensing-Signals-at-232.04-Hz-in-O4a`
- Resonant Hunter v8.4: 10.5281/zenodo.18446712
- UAT Theory: 10.5281/zenodo.17729221
- UPC Principle: 10.5281/zenodo.18210808

The complete v9.0/v9.1 pipeline, together with the `3_Tiempos_Material_Suplementary.txt` file containing all code variants (including those that produced divergences or NaN chains), is available at `https://doi.org/10.5281/zenodo.20601264`.

References

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