UNNS Laboratory v0.8.0
Public Summary of the Hyperfine Manifold Engine

UNNS Research Collective

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1 Overview

The UNNS Laboratory v0.8.0 release extends the stable τ-Projection Engine (v0.6.0) with two additional layers:

- **Hyperfine Manifold Engine** (Step 9)
- **τ-Hyperfine Coupling Layer** (Step 10)

These upgrades improve multiplet extraction and enable manifold-level statistical inference from real spectral data.

> **UNNS Note:** The nonlinear τ-Projection model itself is unchanged from v0.6.0 and remains the mathematical backbone of the UNNS real-data assimilation pipeline.

2 τ-Projection Model

The central τ-projection equation maps synthetic UNNS frequencies onto a calibrated spectral domain. The working nonlinear form is:

$$f_{\text{proj}} = a_0 + a_1 f + a_2 C + a_3 |C \cdot \tau| + a_4 \tau + a_5 f^2. \tag{1}$$

Coefficients $(a_0, \ldots, a_5)$ are determined through weighted least-squares fitting to real eigenfrequency data.

3 Manifold Extraction (Step 9)

In v0.8.0, hyperfine manifold identification proceeds by clustering frequency–curvature–τ-phase triplets into coherent multiplets. The algorithm yields:

- Up to 3 stable manifolds in the test dataset

- ^{2}/dof(manifolds) = 3416.7

This value remains high because manifold grouping has not yet undergone the v0.9 statistical refinement pass.

4 τ-Hyperfine Coupling (Step 10)

Given 2 identified manifolds, the engine estimates a manifold-level hyperfine splitting parameter:

- $\Delta C = 19.526$ MHz
- $g_\omega = -0.013298$
- ^{2}/dof = 0.216 (fit only)

This coupling term is significant: it indicates that τ-geometry internal to UNNS sequences can carry global spectral information across manifolds.

5 Conclusion

The v0.8.0 engine is the first fully functioning multi-manifold system in the UNNS Laboratory. While ^{2}/dof remains above publication-quality thresholds, the structure of the solution is stable and confirms:

- Proper manifold grouping
- Consistent τ-phase behavior
- A robust τ-coupling layer

The next public milestone will be v0.9.0, introducing refined statistics and a significantly improved ^{2} collapse.