# Observer Coherence and Quantum Deviations: A Triple-Blind Experimental Framework

Justin Todd Bogner

June 20, 2025

**Abstract**

This study proposes three rigorously controlled experiments to test whether *measurable* observer coherence (quantified by EEG phase-locking value or computational metrics) correlates with deviations from standard quantum statistics. All designs implement triple-blinding, pre-registered protocols, and open data sharing. The framework makes no theoretical claims about underlying mechanisms. By decoupling analysis from metaphysical assumptions, it enables decisive empirical evaluation of observer influence on quantum phenomena. Null results will constrain models proposing consciousness-mediated effects; positive results will necessitate new physical explanations.

## Core Experimental Hypotheses

1. **H1 (Bell Test)**: CHSH parameter $S$ correlates with EEG gamma-band PLV ($\rho \neq 0$), where $\rho$ is the Pearson correlation coefficient.
2. **H2 (Decoherence)**: NV-center $T_2$ time correlates with proximate observer PLV ($\rho \neq 0$).
3. **H3 (Interference)**: Double-slit visibility $V$ differs during high vs. low coherence states ($\Delta V \neq 0$).

## Experimental Designs

### 1. EEG-Gated Bell Test

- **Protocol**:
  - SPDC source (810 nm), 12m physical separation (ensures spacelike separation)
  - SNSPD detectors (93% QE), real-time PLV computation @ 200 Hz (3545 Hz gamma band)
  - PLV epochs pre-labeled; experimenters/participants/analysts blind to labels (triple-blind)
- **Null Hypothesis**: $\mathcal{H}_0 : \mu(S|\text{high PLV}) = \mu(S|\text{low PLV})$
- **Power Analysis**: $N = 400,000$ trials detects $\Delta S = 0.15$ with 90% power ($\alpha = 0.001$)

### 2. NV-Center Decoherence Protocol

- **Protocol**:
  - Diamond NV-centers in 4K cryostat, $B_0 < 10^{-9}$ T magnetic shielding
  - Continuous $T_2$ monitoring with synchronized EEG (PLV computed in same gamma band)
  - Sham control: Synthetic EEG input with matched statistical structure
- **Metric**: $\Delta(T_2^{-1}) = (T_2^{-1}|\text{high PLV}) - (T_2^{-1}|\text{low PLV})$
- **Sensitivity**: Detects $\delta(T_2^{-1}) \geq 10^{-4}$ ns$^{-1}$ (99% CI)

### 3. Double-Slit Visibility Measurement

- **Protocol**:
  - Single-photon source (405 nm), EMCCD detection with sub-nanowatt power
  - QRNG-gated observer focus vs. rest epochs (volitional modulation)
  - Visibility $V = (I_{\max} - I_{\min})/(I_{\max} + I_{\min})$
- **Control**: Baseline $V_0$ measured without observers present
- **Threshold**: $\Delta V = |V_{\text{focus}} - V_{\text{rest}}| > 0.01$ $(3\sigma)$

## Transparency Safeguards

- **Pre-registration**: OSF-9K7P2 (hypotheses, protocols, analysis plans)
- **Open Data**: All raw data uploaded to Zenodo within 24h of acquisition
- **Code Verification**: Full analysis pipeline available at `github.com/jtbogner/coherence-qm`
- **Artifact Handling**: CNN-based EEG artifact rejection with null-simulation pipeline validation

## Interpretation Framework

- **Positive Result**: Rejection of $\mathcal{H}_0$ ($p < 0.001$ corrected) across $\geq 2$ experiments warrants new physical models. Potential implications include modifications to decoherence theory or consideration of consciousness-field interactions.
- **Null Result**: $|\rho| < 0.01$, $\Delta(T_2^{-1}) < 10^{-5}$ ns$^{-1}$, $\Delta V < 0.005$ constrains observer-mediated effects to sub-detection thresholds under current instrumentation.