# UTRE — Experimental Validation Plan

Harmonic Nexus Core (HNC) • Illumination Chip • A.L.F.I.E. • EPAS

## 1. Purpose & Scope

This plan defines the experimental validation required to demonstrate reproducible resonance indices (Ψ■, ΔM, R(t)) across hardware (HNC devices) and humanware (HRV/EEG cohorts), following the UTRE Sections 1–7. All studies are preregistered, multi-site, and open-data with cryptographic integrity seals.

## 2. Objectives & Hypotheses

| Objective | Primary Endpoint | Hypothesis |
|---|---|---|
| Hardware: ZPE/DCE extraction | ΔM beyond controls; energy balance anomaly | Illumination Chips exhibit statistically significant ΔM |
| Humanware: coherence entrainment | ΔR(t) slope increase vs sham | 0.1 Hz entrainment yields higher HRV/EEG coheren |
| Integration: planetary coupling | Cross-correlation with Kp/Ap/Schumann | Device + human ΔM correlate with planetary drivers |

## 3. Study Design

Multi-site, parallel tracks (hardware & humanware), 12-month pilot. Minimum of three independent laboratories per track, with replication required at ≥ 2 sites. Blinding, sham controls, and standardized pipelines for Ψ■, ΔM, R(t).

## 4. Metrics & Definitions

| Index | Definition | Units / Notes |
|---|---|---|
| Ψ■ (Origin) | Band-limited spectral power above noise | V²/Hz (devices), ms²/μV² (HRV/EEG) |
| ΔM (Operation) | Shift in coherence or spectral power vs baseline | Unitless z-score / rate changes |
| R(t) (Trajectory) | Time-derivative/slope of coherence indices | ΔΓ/Δt (per min) |
| Γ (Coherence) | Normalized variance of dominant frequency stability | 0–1, target ≥ 0.945 |
| Integrity Index | SNR × stability duration | Unitless |
| Resonance Index | Peak sharpness × phase-lock ratio | Unitless |

## 5. Hardware Protocol (Illumination Chip / DCE Platforms)

Devices: Illumination Chips, Casimir microcavities, SNSPD photon detectors. Baselines: shielded runs, dummy loads, off-resonance modulation.

| Procedure | Instrumentation / Settings | Data Products |
|---|---|---|
| Gate-A validation | SNSPDs ($g^2(0)$), calibrated timing jitter; Faraday/cryogenic shielding | Photon counts, $g^2(0)$, jitter histograms |
| Energy balance | Precision power meters (DC/AC), 4-wire shunts, thermal sensors | Power logs, error bounds |
| Coherence runs | Resonant modulation, coil B-fields, RF drive sweep | Γ, ΔM, R(t), PSDs, waveforms |

## 6. Humanware Protocol (HRV/EEG Entrainment)

Participants: n ≥ 30 per arm, randomized (entrainment vs sham). Interventions: 0.1 Hz breathing vs non-resonant sham. Data: RR intervals, EEG (alpha), cortisol assays, journaling.

| Procedure | Instrumentation / Settings | Data Products |
|---|---|---|
| Baseline & sham | ECG (250–1000 Hz), EEG (19–32 ch), saliva cortisol | Ψ■ (HRV/EEG), baselines |
| Entrainment | Paced breathing @0.1 Hz, eyes-closed EEG | ΔM, Γ, phase-lock ratios |
| Recovery & follow-up | Repeat HRV/EEG + cortisol (24–72h) | R(t) slopes, resilience scores |

## 7. Controls, Randomization, Blinding

Hardware: dummy loads, off-resonance runs, thermal-only profiles. Humanware: sham breathing, eyes-open EEG baselines. Randomization stratified by site; analysts blinded to condition labels.

## 8. Instrumentation & Calibration

- Power: DC/AC meters (traceable), 4-wire shunts, thermal cameras/RTDs.
- RF/EM: spectrum analyzers, lock-ins, B-dot/Hall probes, EMI current clamps.
- Photonics: SNSPD/APD detectors, time-taggers (<50 ps), dark-rate controls.
- Bio: 3-lead ECG, 19–32ch EEG, validated breath pacers, salivary cortisol kits.
- Calibration: daily functional checks; weekly traceable calibrations; inter-site round robin.

## 9. Data Management & Integrity

All raw time-series, metadata, and analysis scripts are stored in a shared repository (e.g., Supabase/GitHub). Files are hashed (SHA256). Access: aggregate public; raw under DUA. All analyses are containerized for reproducibility.

## 10. Statistical Analysis Plan

| Analysis | Method | Notes |
|---|---|---|
| Primary endpoints | Paired/within-subject tests (Welch t, Wilcoxon); effect sizes (Cohen's d, Cliff's δ) | Holm/BH correction for multiplicity |
| Time-trajectory | Mixed-effects models on R(t); slope comparisons | Random intercepts by subject/site |
| Planetary coupling | Cross-correlation; surrogate phase randomization | Predefined lags; null via surrogates |
| Rare-event risk | Monte Carlo (≥10■) with variance reduction | Upper confidence bounds reported |

## 11. Validation & Success Criteria

| Track | Criteria |
|---|---|
| Hardware | $\Delta M$ replicated in ≥ 2 labs; energy anomalies beyond error bounds; $\Gamma \geq 0.945$ |
| Humanware | $\Delta M$ replicated in ≥ 2 cohorts; HRV/EEG coherence > sham ($p < 0.05$) |
| Integration | Significant R(t) correlation with planetary drivers across tracks |

## 12. Ethics, Safety & Governance

Human studies: IRB approval, informed consent, anonymization. Device tests: hazard analysis (FMEA), HALT/HASS screening. Governance: UTRE Oversight Board; preregistration and open protocols; no clinical claims; non-coercive participation.

## 13. Timeline & Milestones (12-Month Pilot)

| Phase | Months | Milestones |
|---|---|---|
| Setup & calibration | 0–2 | Site onboarding, protocol training, round-robin calibration |
| Pilot runs | 3–5 | First Ψ■/ΔM/R(t) datasets; analysis pipeline lock |
| Replication | 6–9 | Cross-site replication; interim report |
| Synthesis & publication | 10–12 | Hardware + humanware manuscripts; UTRE synthesis preprint |

## 14. Reviewer Checklists

| Domain | Checklist (pass/fail) |
|---|---|
| Design | Endpoints preregistered; controls defined; blinding; replication plan |

| | |
|---|---|
| Hardware | Gate-A, energy balance, EMI guard, cryptographic hashes |
| Humanware | Randomization, sham, IRB, anonymization |
| Stats | Power calc, corrections, surrogates, mixed-effects for R(t) |
| Data | Open repo, versioned code, containerized analysis |