First‑Signal Law (FSL) – Biofilm Stability Handout

# Core Idea

Biofilm stability follows the ordering Restraint ≥ Alignment ≥ Persistence (R ≥ A ≥ P). When roles are balanced in this order, biofilms are stable. When mis‑ordered (e.g., Persistence outruns Alignment, or Alignment dominates without Restraint), systems become brittle or collapse.

# Key Roles & Proxies

• Restraint (R): space/porosity, nutrient moderation, conservative stress ceiling.

• Alignment (A): Song (quorum‑signal coherence, harmony) vs Rhythm (oscillatory synchrony without harmony).

• Persistence (P): EPS maturity (matrix density/viscoelasticity, scaffold memory floor).

• Release (L): anchored dispersion events that expand outward while reinforcing scaffold.

# Threshold Predictions (Falsifiable)

1. If R ≥ 0.5, A\_song ≥ 0.5, P ≥ A\_song → stability ≥ 0.65.

2. If Space < 0.35 → stability ≤ 0.45 or variance spikes.

3. If A\_rhythm − A\_song ≥ 0.2 and R < 0.5 → stability ≤ 0.5, even with high P.

4. Release (L ≥ 0.4) improves stability only if R ≥ 0.5; otherwise no gain.

5. Mature EPS (P ≥ 0.6) creates a floor: stability never < 0.35 even with weak A.

6. At equal R, higher A\_song beats higher nutrients with low coherence.

# Practical Use

Reinterpret existing datasets by mapping common outputs to these proxies. Normalize to [0,1], score Ordered (R ≥ A ≥ P) vs Unordered conditions, and compare late‑window stability. This provides a simple test of the First‑Signal Law using measurements you already have.

# Next Steps

• Slice past data into Ordered vs Unordered and compare stability.  
• Run comparative grids (Space × Harmony, Restraint × Release, EPS maturity × Alignment).  
• Document exceptions – they reveal where proxy mappings need refinement.

Contact: Share results or feedback for cross‑domain testing of the First‑Signal Law framework.