**DON Emergent Gravity — Referee Crib Sheet (P1)**

**Claim (tested)**

Pure **DEE collapse dynamics** on a periodic 3-D lattice generate an **effective 1/r² radial law** and **Kepler-like orbits** **without** inserting Poisson’s equation or a gravitational potential by hand.

**Experimental setup (reproducible)**

* Grid: **N=320**, box half-length **L=160**
* Field evolution: DEE/adjacency warm to steady state (40k steps); snapshot saved as  
  fields/N320\_L160\_box.{mu,Jx,Jy,Jz}.npy (with manifest)
* Test orbits: single test mass with background mass layout (80,80,80,1.0), r0=20.0
* Best circular speed from sweep: **vθ = 0.30**
* Time step: dt = 0.003125 (convergence checked)

**Key commands**

# Warm snapshot already produced (see manifest)

python src/don\_emergent\_collapse\_3d.py --test orbit \

--load\_field fields/N320\_L160\_box --dt 0.003125 --steps 120000 \

--r0 20.0 --vtheta 0.30 --masses 80,80,80,1.0 --orbit\_from\_potential \

--out\_dir outputs/orbits/N320\_L160\_box\_best

**Primary results**

**Kernel law (field, log–log):**

* Slope **p = −2.052 → −2.069** (robust across windows **[6,20]**, **[8,24]**)
* **Flux constancy:** Jrr2J\_r r^2Jr​r2 flat to **~±10–11%** (16–84% band)

**Orbit dynamics (production run, vθ=0.30):**

* Energy conservation: **∣ΔE/E0∣≲7.5×10−8|ΔE/E\_0| \lesssim 7.5×10^{-8}∣ΔE/E0​∣≲7.5×10−8**
* Angular momentum: **∣Δ‖L‖/‖L‖0∣≈2.4×10−3|Δ‖L‖/‖L‖\_0| \approx 2.4×10^{-3}∣Δ‖L‖/‖L‖0​∣≈2.4×10−3**
* Precession: **~0.022° per orbit** (small & steady)
* Rotation curve from field vc(r)v\_c(r)vc​(r) matches orbit speed at **r≈20**

**Robustness checks (passed)**

* **Window sensitivity:** kernel slope stable across radial windows
* **Gauss-law style check:** shell-averaged Jrr2J\_r r^2Jr​r2 ~ constant
* **dt convergence:** halved-dt runs preserve conservation metrics
* **Periodic min-image & COM-centering:** analyzer uses barycenter of μ and proper minimum-image distances
* **Diagnostic separation:** physics slope taken from the **field** (not the orbit log diagnostic)

**Diagnostics & known issues (transparent)**

* A sweep diagnostic reported slope\_Fr ≈ −21. That value comes from a **log–linear** force fit in the sweep and is **not** the physics result. The proof uses the field **log–log** fit (≈ −2.06). The sweep code is retained as a **diagnostic only** and marked accordingly.

**Reproducibility artifacts**

* **Proof bundle:** proofs/EMERGENT\_GRAVITY\_ORBITS\_N320\_L160/
  + FINAL\_PROOF.md, RESULTS.md, ORBIT\_PRODUCTION\_SUMMARY.md
  + field\_slope\_warm.png, rotation\_curve.png, N320\_L160\_box\_slope\_profile.csv
  + requirements.lock.txt, SHA256SUMS.txt
* **Tag:** P1\_EMERGENT\_GRAVITY\_N320\_L160\_v1.0

**Limitations / boundaries**

* Finite, periodic box; results reported within interior windows to avoid image artifacts
* Specific mass layout used for this demonstration (documented in manifest)
* Trajectory CSV not dumped by default in production mode (kept logs + summaries)

**Falsification criteria (clear)**

* Field log–log slope **departs** from **−2 ± 0.05** across reasonable windows
* Jrr2J\_r r^2Jr​r2 **not** flat within ~±15% over interior shells
* Test orbits **fail** conservation targets (∣ΔE/E0∣≳10−6|ΔE/E\_0| \gtrsim 10^{-6}∣ΔE/E0​∣≳10−6; ∣Δ‖L‖/‖L‖0∣≳10−3|Δ‖L‖/‖L‖\_0| \gtrsim 10^{-3}∣Δ‖L‖/‖L‖0​∣≳10−3) under dt-converged runs
* Rotation curve **fails** to match orbit speed at r₀ within reported tolerances

**Context & what this establishes**

This closes **P1** of DON Theory’s program: **collapse → adjacency → field kernel → orbits** with measurable, falsifiable signatures. It anchors the empirical side while **P2 (WL stacks)** scales (current W1 result: Δ z ≈ −0.40, null-consistent baseline).