

# MINIMAL FIRST TEST

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UDEL recoil signature in one attractor basin

BY

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The minimal first test for UDEL recoil: a focused question about one attractor basin, one dataset, and one primary statistic. Small enough to attempt, hard enough to matter, focused enough to falsify.

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## I Basin to Target

Start with the classical Great Attractor / Hydra–Centaurus–Norma direction — not because it is proven to be one unique master attractor, but because it is historically central, nearby enough for peculiar-velocity work, and already embedded in the modern multi-basin flow picture.

Recent mapping work treats the local flow as a basin landscape rather than one single dominant object, and Cosmicflows-4-based studies explicitly map multiple basins of attraction in the local universe.

### Three advantages of this basin first:

- 1. Lots of existing flow context.** Cosmicflows-4 compiles distances for 55,877 galaxies grouped into 38,065 systems — exactly the kind of input needed for peculiar-velocity reconstruction.
- 2. Independent new peculiar-velocity data are arriving.** The DESI peculiar-velocity program is designed to measure peculiar velocities using the Fundamental Plane and Tully–Fisher relations. DESI DR1 peculiar-velocity catalogs are now being released.
- 3. The Great Attractor is already under scrutiny.** A recent 2026 analysis argues the classical Great Attractor is not a single dynamically dominant structure — which makes it an excellent place to ask whether something more than standard interpretation is hiding in the basin behavior.

## II The Question

*Does the basin strength in the Hydra–Centaurus / Great Attractor direction deepen toward low redshift more than standard structure growth predicts?*

That is the sharp version. Not: 'Can we prove UDEL from attractors?' Not: 'Can we prove collapse has started?' Only: is this basin strengthening too much, too fast, or with too much pull for mapped mass?

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## III The Observable Chain

The full observable chain:

redshift + independent distance -> peculiar velocity  
 -> reconstructed convergence -> basin depth

Mathematically, for each galaxy:

$$v_{\text{pec},||} = v_{\text{obs}} - H(z) * d$$

Reconstruct a smoothed velocity field  $v(x)$ , and compute:

$$\Theta(x) = \nabla * v(x)$$

(negative divergence indicates attractor-like convergence)

Define a basin-depth metric in the target region:

$$A_k = -\langle \nabla * v \rangle_{\{B,k\}} \text{ for shell } k$$

This is the primary test statistic.

## IV The Datasets

### **Phase 1 dataset: Cosmicflows-4**

Already built for peculiar-velocity / local-flow work and large enough to support a first basin analysis.

### **Phase 2 dataset: DESI peculiar-velocity data**

DESI's PV program is explicitly built to derive peculiar velocities from Fundamental Plane and Tully–Fisher distances. DESI DR1 PV products are now being described publicly. This gives a natural sequence: first test with Cosmicflows-4, then stress-test with DESI PV.

## V The Shell Split

Use three radial shells only — near, middle, far. Do not overcomplicate the first pass. For each shell, measure:

- Basin center
- Basin depth  $A_k$
- Basin width
- Optional pull-to-mass ratio, if a mass proxy can be assembled

The goal is not perfection. The goal is to see whether anything looks systematically too strong at late times.

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## VI The Two Nulls

### Null 1: Standard growth only.

Assume ordinary large-scale structure growth in LambdaCDM-like cosmology.

### Null 2: Standard growth + survey and systematic effects.

Because peculiar velocities are noisy, and distance-indicator scatter matters. Cosmicflows and DESI both emphasize that peculiar-velocity work is systematics-sensitive. If a signal vanishes under realistic systematics, it is not worth promoting.

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## VII What Would Be Interesting

Any one of the following would justify going further:

1. **Excess low-redshift deepening:** if the nearest shell shows basin depth significantly stronger than extrapolated from the farther shells under standard growth.
  2. **Pull stronger than mapped matter supports:** if the reconstructed flow implies stronger convergence than visible plus inferred mass reasonably predicts.
  3. **Multi-basin consistency:** if the same kind of excess appears later in another basin (such as Shapley). Modern mapping already identifies several basin-of-attraction regions, so replication would matter a lot.
  4. **Directional asymmetry:** if strengthening aligns with some recoil-like preferred structure rather than generic basin scatter.
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## VIII What Would Kill It Early

- Basin-depth evolution matches standard growth within uncertainty
- No low-redshift excess appears
- Flow-inferred pull matches mapped mass cleanly
- The effect is inconsistent between catalogs
- The apparent signal can be reproduced by known distance-bias or reconstruction artifacts

*That would not kill UDEL as a whole — but it would kill this attractor proof path. The falsifiers are not a weakness. They are what makes the program scientific.*

## **IX Why This Is the Right Next Step**

Because it is:

- Small enough to attempt
- Hard enough to matter
- Focused enough to falsify

And it does not require solving all of recoil at once.