Finite-Element Discrimination of Boundary-Flux, Scalar, and Conventional Artifact Forces in Asymmetric Capacitors

A Computational Design Atlas for Electrostatic Anomaly Experiments

JMP0X1B Research Group

June 6, 2026

Abstract. This paper proposes a finite-element and reduced-order modeling framework for designing capacitor experiments that discriminate among conventional artifacts and speculative five-dimensional projection residuals. The goal is not to maximize force. The goal is to maximize identifiability. Ordinary Maxwell stress, electrohydrodynamic gas drift, leakage-current forces, dielectric heating, thermal expansion, scalar-energy proxies, and boundary-flux proxies are computed on the same electrode geometries. Candidate geometries are scored by how differently these mechanisms transform under pressure reduction, voltage reversal, device inversion, grounded shielding, edge smoothing, and scale changes. The output is a design atlas for high-vacuum experiments: which shapes are poor because every mechanism is degenerate, which shapes are useful as controls, and which shapes amplify one speculative operator family while suppressing conventional impostors.

Working-paper status. This manuscript is speculative and methodological. It makes no claim of experimentally demonstrated exotic propulsion, room-temperature superconductivity, inertial-mass reduction, or gravitational-wave generation. Its purpose is to state assumptions, formalize hypotheses, and define tests whose null outcomes are scientifically useful.

Contents

1 Problem

A capacitor geometry can produce a measurable displacement for many reasons. Some reasons are ordinary electromagnetic stress. Some are gas-mediated electrohydrodynamic forces. Some are thermal or mechanical. Some are wiring artifacts. The JMP0X1B boundary-flux and weak-field radion papers propose speculative residuals, but they also emphasize null observables and artifact rejection [1, 2]. This paper provides the computational layer between theory and bench experiment.

A key design principle follows:

> The best geometry for a speculative experiment is not the geometry with the largest total force. It is the geometry where competing mechanisms have the most distinguishable transformation laws.

2 Field model

Let Ω be the computational domain containing electrodes, dielectrics, supports, shields, and residual gas. The electrostatic potential solves

$$\nabla \cdot (\epsilon(\mathbf{x})\nabla\Phi) = -\rho_f, \qquad \mathbf{E} = -\nabla\Phi. \tag{1}$$

The ordinary Maxwell stress tensor is

$$T_{ij} = \epsilon\left(E_iE_j - \frac{1}{2}\delta_{ij}E^2\right), \tag{2}$$

with force on a body B

$$F_i^M = \oint_{\partial B} T_{ij}n_j\, dA. \tag{3}$$

This baseline is mandatory. Any residual must be measured relative to it, not relative to intuition.

3 Artifact models

3.1 Gas-mediated electrohydrodynamics

In gas, a minimal ion-drift proxy is

$$\mathbf{f}_{\text{EHD}} = \rho_i\mathbf{E} - \nabla p_i, \tag{4}$$

where ρ_i is an effective space-charge density. For design purposes, ρ_i can be parameterized by field threshold, humidity, pressure, and electrode curvature. This is not a full plasma model; it is an artifact discriminator.

3.2 Leakage and Joule heating

A dielectric or surface leakage channel produces heat

$$q(\mathbf{x}) = \sigma(\mathbf{x})E^2, \tag{5}$$

which couples to thermal expansion, radiometric effects, and support creep. A good null geometry should include deliberate leakage dummies so that this response is measured rather than assumed.

3.3 Cable and support coupling

Power leads can experience Lorentz forces, electrostatic attraction to chamber walls, and thermal strain. In simulation they are represented as external force priors with experimentally measured transfer functions.

4 Speculative residual proxies

The scalar-energy proxy uses the electric energy density

$$u_E(\mathbf{x}) = \frac{1}{2}\epsilon E^2 \tag{6}$$

and a Yukawa-like kernel

$$\Psi_s(\mathbf{x}) = \int_\Omega u_E(\mathbf{x}') \frac{e^{-|\mathbf{x}-\mathbf{x}'|/\lambda}}{4\pi|\mathbf{x}-\mathbf{x}'|}\, d^3x'. \tag{7}$$

A force proxy on a test body can be written

$$\mathbf{F}_s = -\gamma_s \int_B \rho_B(\mathbf{x}) \nabla \Psi_s(\mathbf{x})\, d^3x. \tag{8}$$

The boundary-flux proxy is represented by an edge functional

$$B(\mathcal{G}) = \int_{\partial\Omega_e} w(\kappa, \nabla\epsilon, n)\, E_n^2\, dA, \tag{9}$$

where κ denotes curvature, E_n normal field, and w a declared weighting. This proxy is not a proof of boundary-flux physics; it is a geometry selector.

5 Discrimination score

For a geometry $\mathcal{G}$, construct a signature vector

$$\mathbf{s}_m(\mathcal{G}) = \left(\frac{\partial F_m}{\partial \log P}, \frac{\partial F_m}{\partial V^2}, \frac{F_m(\mathcal{I}\mathcal{G})}{F_m(\mathcal{G})}, \frac{F_m(\text{shielded})}{F_m(\text{open})}, \frac{\partial F_m}{\partial r_e} \right), \tag{10}$$

where m indexes mechanisms and r_e is an edge radius. The discrimination score is

$$D(\mathcal{G}) = \min_{m \neq n} \|\mathbf{s}_m(\mathcal{G}) - \mathbf{s}_n(\mathcal{G})\|_{\Sigma^{-1}}\,. \tag{11}$$

High D means the geometry is useful. Low D means the geometry is scientifically ambiguous.

6 Geometry atlas

Geometry class	Use	Risk
Needle-plane	EHD and corona calibration	dominated by gas discharge; poor vacuum extrapolation

Rounded asymmetric plates	moderate boundary sensitivity	thermal and support coupling may dominate
Symmetric plates	Maxwell-stress control	low sensitivity to edge hypotheses
Interdigitated edges	boundary-flux discriminator	fabrication tolerances matter
Coaxial guarded capacitor	leakage and shielding control	may suppress the residual being tested
Scale-pair replicas	range and gradient discrimination	difficult to match surface finish

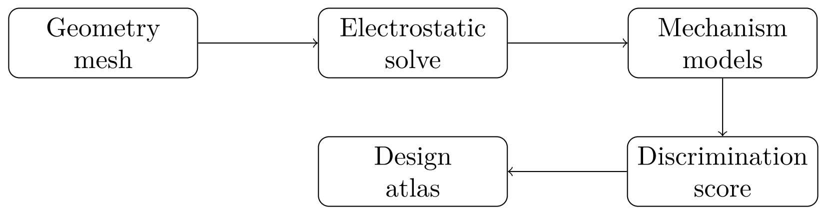

Figure 1: Computational path from electrode geometry to experiment-design recommendations.

7 Claims

Claim 1. *Force-maximizing geometries are often poor anomaly-search geometries because they amplify multiple conventional artifacts simultaneously.*

Claim 2. *A geometry atlas should be published before the experiment is run, so that post-hoc interpretation cannot choose whichever model fits the result.*

8 Release notes

A proper release includes meshes, material-property priors, solver settings, convergence tests, force-surface definitions, and generated signature vectors. The atlas should be versioned because geometry design will evolve as experiments reveal which artifacts dominate.

References

[1] JMP0X1B Research. *Boundary-Flux Electromagnetism on Embedded Four-Manifolds and Null Observables for Capacitor Residuals*. Working paper, 2026. https://research.jmp0x1b.com/papers/boundary_flux_hypersurface_nulls.pdf.

[2] JMP0X1B Research. *Weak-Field Radion Electrogravity from Maxwell-Compatible Five-Dimensional Projections*. Working paper, 2026. https://research.jmp0x1b.com/papers/weak_field_radion_electrogravity.pdf.

[3] M. Tajmar, M. Kossling, and O. Neunzig. *In-depth experimental search for a coupling between gravity and electromagnetism with steady fields*. Scientific Reports 14, 19427, 2024. https://www.nature.com/articles/s41598-024-70286-w.

[4] B. Gilmore and M. Barrett. *Electrohydrodynamic thrust generation: modeling and experimental considerations*. Representative EHD literature and reviews.

[5] J. D. Jackson. *Classical Electrodynamics*. 3rd ed., Wiley, 1999.