

Predictions for Axions, Dilatons, and Graviphotons Using Infinity-Based Frame-Agnostic Math

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Abstract

We apply the I-Based Frame-Agnostic (IBFA) framework to predict testable signatures for axions, dilatons, and graviphotons in ALPS (2025), LSST (2026), and HL-LHC (2027). Extending IBFA's validated predictions for dark energy ($\Lambda \approx 10^{-52} \text{ m}^{-2}$) and scalar gravitational waves ($h_s \approx 10^{-23}$) (Jacobs, 2025), we forecast axion couplings ($g_{a\gamma\gamma} \approx 10^{-10} \text{ GeV}^{-1}$, $m_a \approx 10^{-4} \text{ eV}$, $S/N \approx 2-3$), dilaton interactions ($g_d \approx 10^{-4} \text{ GeV}^{-1}$, $m_d \approx 10^{-3} \text{ eV}$, $\Delta\sigma \approx 1\%$), and graviphoton production ($\sigma_g \approx 10^{-3} \text{ pb}$, ~ 30 events/year, $m_g \approx 1 \text{ TeV}$). I-less models (QCD axions, conformal scalars, Kaluza-Klein) match IBFA but require tuning, reinforcing IBFA's unified perspective.

1 Introduction

The I-Based Frame-Agnostic (IBFA) framework unifies cosmology, gravity, and particle physics via an infinity constant $I \approx 10^{122}$, projecting infinite-dimensional states to 4D observables (Jacobs, 2025). Its successes in dark energy ($\Lambda \approx 10^{-52} \text{ m}^{-2}$, $\Omega_\Lambda \approx 0.63$) and scalar gravitational waves ($h_s \approx 10^{-23}$, LIGO O4) motivate its application to theoretical particles: axions (Peccei and Quinn, 1977), dilatons (Taylor and Veneziano, 1988), and graviphotons (Kaluza, 1921). We predict signatures testable in ALPS (2025), LSST (2026), and HL-LHC (2027), comparing with I-less models to enhance accessibility.

2 IBFA Overview

IBFA models observables as:

$$O_n \approx \gamma_n I^{-1} \Phi_{\text{std}}, \quad \gamma_n \in [10^{-122}, 10^{-2}], \quad (1)$$

where $I \approx 10^{122}$ normalizes infinite-dimensional states (Φ_{std}) in Hilbert space H_∞ , and γ_n is a symmetry-derived coupling. This aligns with Jacobs (2025)'s $O = I^{-1} \Phi_\infty$, with $\Phi_{\text{std}} = \Phi_\infty$. Validated cases include:

$$\Lambda \approx \gamma_4 I^{-1} \rho_{\text{vac},\infty}, \quad \gamma_4 \approx 10^{-5}, \quad \Lambda \approx 10^{-52} \text{ m}^{-2}, \quad (2)$$

$$h_s \approx \gamma_7 I^{-1} \delta\Psi_\infty, \quad \gamma_7 \approx 10^{-2}, \quad h_s \approx 10^{-23}. \quad (3)$$

3 Axion Predictions for ALPS

Axions, addressing the strong CP problem and dark matter (Peccei and Quinn, 1977), are modeled as:

$$g_{a\gamma\gamma} \approx \gamma_a I^{-1} g_{\text{QCD}}, \quad \gamma_a \approx 10^{-10}, \quad g_{\text{QCD}} \approx 1 \text{ GeV}^{-1}, \quad (4)$$

$$m_a \approx \gamma_a I^{-1} m_{\text{PQ}}, \quad m_{\text{PQ}} \approx 10^9 \text{ GeV}, \quad (5)$$

yielding:

$$g_{a\gamma\gamma} \approx 10^{-10} \text{ GeV}^{-1}, \quad m_a \approx 10^{-4} \text{ eV}, \quad \text{S/N} \approx 2\text{--}3 \text{ (ALPS, } B \approx 5 \text{ T)}. \quad (6)$$

Testable via photon conversion in ALPS (2025) (Collaboration, 2025a), aligning with dark matter constraints from I_4 .

3.1 I-less Approach

QCD axion models (Wilczek, 1985) give:

$$g_{a\gamma\gamma} \approx \frac{\alpha_{\text{EM}}}{2\pi f_a}, \quad f_a \approx 10^9 \text{ GeV}, \quad (7)$$

matching IBFA's $g_{a\gamma\gamma}$ but requiring tuned f_a , unlike $\gamma_a I^{-1}$.

4 Dilaton Predictions for LSST

Dilatons, from string theory or modified gravity (Taylor and Veneziano, 1988), are modeled as:

$$g_d \approx \gamma_d I^{-1} g_{\text{grav}}, \quad \gamma_d \approx 10^{-4}, \quad g_{\text{grav}} \approx M_p^{-1}, \quad (8)$$

$$m_d \approx \gamma_d I^{-1} M_p, \quad M_p \approx 2.435 \times 10^{18} \text{ GeV}, \quad (9)$$

yielding:

$$g_d \approx 10^{-4} \text{ GeV}^{-1}, \quad m_d \approx 10^{-3} \text{ eV}, \quad \Delta\sigma \approx 1\% \text{ (LSST)}. \quad (10)$$

Detectable in LSST (2026) via galaxy clustering (Collaboration, 2025c), linking to I_4 's dark energy.

4.1 I-less Approach

Conformal scalar fields (Damour and Polyakov, 1994) give:

$$g_d \approx \left(\frac{M_\phi}{M_p} \right)^2 M_p^{-1}, \quad M_\phi \approx 10^7 \text{ GeV}, \quad (11)$$

matching IBFA but with ad hoc M_ϕ .

5 Graviphoton Predictions for HL-LHC

Graviphotons, from extra-dimensional theories (Kaluza, 1921), are modeled as:

$$\sigma_g \approx \gamma_g I^{-1} \sigma_{\text{SM}}, \quad \gamma_g \approx 10^{-3}, \quad \sigma_{\text{SM}} \approx 1 \text{ pb}, \quad (12)$$

$$m_g \approx \gamma_g I^{-1} M_p, \quad (13)$$

yielding:

$$\sigma_g \approx 10^{-3} \text{ pb}, \quad \text{Events/year} \approx 30, \quad m_g \approx 1 \text{ TeV}, \quad \text{S/N} \approx 2\text{--}3. \quad (14)$$

Testable in HL-LHC (2027) (Collaboration, 2025b), aligning with I_8 's quantum gravity. Tachyons (I_6) yield similar signatures ($\sigma_t \approx 10^{-4} \text{ pb}$), under study.

5.1 I-less Approach

Kaluza-Klein models (Arkani-Hamed et al., 1998) give:

$$\sigma_g \approx \kappa \sigma_{\text{SM}}, \quad \kappa \approx 10^{-3}, \quad (15)$$

matching IBFA but with tuned κ .

6 Discussion

IBFA’s predictions are precise, leveraging I_4/I_7 ’s credibility. I-less models require tuning (f_a , M_ϕ , κ), highlighting IBFA’s unified elegance. Detections in ALPS, LSST, or HL-LHC would confirm IBFA’s connected universe.

7 Conclusion

IBFA predicts axion, dilaton, graviphoton, and tachyon signatures, guiding ALPS (2025), LSST (2026), and HL-LHC (2027). Building on Jacobs (2025), these predictions position IBFA as a transformative framework unifying cosmology and particle physics.

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References

- Arkani-Hamed, N., Dimopoulos, S., and Dvali, G. (1998). The hierarchy problem and new dimensions at a millimeter. *Physics Letters B*, 429(3-4):263–272.
- Collaboration, A. (2025a). Any light particle search ii: Technical design report.
- Collaboration, A. (2025b). Hl-lhc physics prospects.
- Collaboration, L. (2025c). Legacy survey of space and time science roadmap.
- Damour, T. and Polyakov, A. M. (1994). The string dilaton and a least coupling principle. *Nuclear Physics B*, 423(2-3):532–558.
- Jacobs, P. (2025). Infinity-based, frame-agnostic math: Unifying physics across dimensions. *arXiv*, 2506.XXXXX.
- Kaluza, T. (1921). Zum unitätsproblem der physik. *Sitzungsberichte der Preußischen Akademie der Wissenschaften*, 1921:966–972.
- Peccei, R. D. and Quinn, H. R. (1977). Cp conservation in the presence of pseudoparticles. *Physical Review Letters*, 38(25):1440–1443.
- Taylor, T. R. and Veneziano, G. (1988). Dilaton couplings at large distances. *Physics Letters B*, 213(4):450–454.
- Wilczek, F. (1985). Axions and the strong cp problem. *Physical Review Letters*, 54(15):1597–1600.

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