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

Paul Jacobs
Independent Researcher
Zer0Theory@proton.me

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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 ($\Lambda \approx 10^{-52}\,\mathrm{m}^{-2}$) and scalar gravitational waves ($h_s \approx 10^{-23}$) (Jacobs, 2025), we forecast axion couplings ($g_{a\gamma\gamma} \approx 10^{-10}\,\mathrm{GeV}^{-1}$, $m_a \approx 10^{-4}\,\mathrm{eV}$, S/N $\approx$ 2–3), dilaton interactions ($g_d \approx 10^{-4}\,\mathrm{GeV}^{-1}$, $m_d \approx 10^{-3}\,\mathrm{eV}$, $\Delta\sigma \approx 1\%$), and graviphoton production ($\sigma_g \approx 10^{-3}\,\mathrm{pb}$, $\sim$30 events/year, $m_g \approx 1\,\mathrm{TeV}$). 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 ($\Lambda \approx 10^{-52}\,\mathrm{m}^{-2}$, $\Omega_\Lambda \approx 0.63$) 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:

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

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 $\Phi_{\mathrm{std}} = \Phi_\infty$. Validated cases include:

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

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

3 Axion Predictions for ALPS

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

$$g_{a\gamma\gamma} \approx \gamma_a I^{-1} g_{\mathrm{QCD}}, \quad \gamma_a \approx 10^{-10}, \quad g_{\mathrm{QCD}} \approx 1\,\mathrm{GeV}^{-1}, \tag{4}$$

$$m_a \approx \gamma_a I^{-1} m_{\mathrm{PQ}}, \quad m_{\mathrm{PQ}} \approx 10^9\,\mathrm{GeV}, \tag{5}$$

yielding:

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

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:

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

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:

$$g_d \approx \gamma_d I^{-1} g_{\mathrm{grav}}, \quad \gamma_d \approx 10^{-4}, \quad g_{\mathrm{grav}} \approx M_p^{-1}, \tag{8}$$

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

yielding:

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

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:

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

matching IBFA but with ad hoc M_ϕ.

5 Graviphoton Predictions for HL-LHC

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

$$\sigma_g \approx \gamma_g I^{-1} \sigma_{\mathrm{SM}}, \quad \gamma_g \approx 10^{-3}, \quad \sigma_{\mathrm{SM}} \approx 1\,\mathrm{pb}, \tag{12}$$

$$m_g \approx \gamma_g I^{-1} M_p, \tag{13}$$

yielding:

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

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

5.1 I-less Approach

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

$$\sigma_g \approx \kappa\sigma_{\mathrm{SM}}, \quad \kappa \approx 10^{-3}, \tag{15}$$

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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