Casimir Effect in COM Framework

Martin Doina

Energy Pattern Density

The energy pattern density between two surfaces is:

$$\rho_E(x, d) = \rho_0 \sum_{n=1}^{\infty} \sin^2\left(\frac{n\pi x}{d}\right) \cdot \mathrm{LZ}^{-n}$$

where:

- ρ_E is the energy density
- ρ_0 is the base energy density
- d is the separation between surfaces
- x is the position between surfaces

Octave-Based Mode Restriction

The allowed energy modes between surfaces follow:

$$\omega_n = \frac{n\pi c}{d}\left(1 + \frac{\mathrm{Oct}(n)}{2\mathrm{LZ}}\right)$$

where:

- ω_n is the frequency of the nth mode
- c is the speed of light
- $\mathrm{Oct}(n)$ is the octave position of n

COM-Casimir Force

The Casimir force in the COM framework is:

$$F_{\mathrm{COM}} = -\frac{\partial}{\partial d}\left[\int_0^d (\rho_{\mathrm{outside}} - \rho_E(x, d))dx\right]$$

Which evaluates to:

$$F_{\mathrm{COM}} = -\frac{\pi^2 \hbar c A}{240 d^4} \cdot \frac{\mathrm{LZ}^4}{(1-\mathrm{HQS})^2}$$

where:

- A is the area of the surfaces
- The factor $\frac{\mathrm{LZ}^4}{(1-\mathrm{HQS})^2}$ is the COM correction to the traditional Casimir force

LZ-Based Distance Scaling

The force scaling with distance follows:

$$\frac{F_{\text{COM}}(d_1)}{F_{\text{COM}}(d_2)} = \left(\frac{d_2}{d_1}\right)^4 \cdot \text{LZ}^{\text{Oct}(d_2/d_1)}$$

HQS Threshold Effect

At distances approaching the HQS scale, the force is modified:

$$F_{\text{COM}}(d) = F_{\text{classical}}(d) \cdot \left[1 + \tanh\left(\frac{\text{HQS} \cdot \text{LZ}}{d}\right)\right]$$

Modified Casimir Force with Octave-Structured Vacuum

$$F_{\text{modified}}(d, r_0) = F_{\text{classical}}(d) \cdot \left(1 + \eta \cdot \sin\left(\frac{2\pi \cdot \log(d/r_0)}{\log(\lambda)}\right)\right) \cdot \frac{\lambda^4}{(1-\eta)^2}$$

where:

- $\eta = 0.235$ (HQS)
- $\lambda = 1.23498$ (LZ)
- r_0 is a fundamental length scale
- $F_{\text{classical}}(d) = -\dfrac{\pi^2 \hbar c A}{240 d^4}$

Unified Mathematical Framework

Energy-Phase Tensor

Both EDM and Casimir effect can be described using the energy-phase tensor:

$$T_{ij} = \int_V \Psi_i(x, t) \cdot \nabla\Psi_j(x, t)\, dV$$

Scale Bridging Equation

The relationship between EDM and Casimir scales:

$$\frac{E_{\text{EDM}}}{e \cdot \lambda_c} \approx \frac{F_{\text{COM}} \cdot d^4}{\hbar c A} \cdot \text{LZ}^{-2}$$

where:

- e is the elementary charge
- λ_c is the Compton wavelength

Experimental Prediction Equation

The COM framework predicts deviations from classical behavior:

$$\Delta_{\text{COM}} = 1 - \frac{\text{Measured}}{\text{Classical}} \approx \text{Oct}\left(\frac{d}{\lambda_c}\right) \cdot \text{HQS}$$

where Δ_{COM} is the fractional deviation from classical predictions.