# Phase 11 – Predictive Power

## Part 3: Deviations from Classical Newtonian Behavior

## Goal

To quantify measurable deviations from Newtonian gravity that arise in ψ-gravity, and to outline potential experimental analogues where these deviations might be observable.

## Classical Benchmark

Newtonian gravitational force between two point masses:

Plain text:  
F\_N(r) = G m1 m2 / r²

## ψ-Gravity Force Expression

The ψ-gravity force is given by:

Plain text:  
F(x) = −∇[(∇²[space(x) + current(x)²]) × ψ(x)]

Deviations appear whenever ψ(x) or current(x)² introduce gradients not reducible to 1/r².

## Sources of Deviations

### 1. ψ Gradients

If ψ varies spatially, its gradient introduces non-Newtonian terms.

Plain text:  
ΔF\_ψ(r) ~ −∇[ψ(r) · f(r)]

Predicted effect:

* Local strengthening of force in regions of steep ψ slope.
* Possible weakening or reversal where ψ is negative.

### 2. Current² Contributions

Dynamic currents add additional Laplacian structure.

Plain text:  
ΔF\_current(r) ~ −∇[(∇² current(r)²) ψ(r)]

Predicted effect:

* Oscillatory force corrections.
* Time-dependent modulation of effective attraction/repulsion.

### 3. Nonlinear Coupling Terms

Combined ψ–current interactions yield higher-order deviations.

Plain text:  
F\_total(r) = F\_N(r) + ΔF\_ψ(r) + ΔF\_current(r)

## Predicted Observable Deviations

### Force Law Modification

Effective scaling deviates from 1/r²:

Plain text:  
F(r) ∝ 1 / r^(2+δ)

Where δ depends on ψ gradient strength and current² contribution.

### Oscillatory Force Corrections

Periodic ψ wells or dunes produce sinusoidal corrections:

Plain text:  
F(r) = (G m1 m2 / r²) · (1 + ε sin(kr))

Observable as periodic drift or oscillatory accelerations.

### Entropy-Driven Drift

Fluctuation–dissipation coupling adds an entropic force term:

Plain text:  
F\_entropy = −T ∇S\_ψ

Observable as diffusion-like drift of test particles beyond Newtonian prediction.

## Simulation: Newtonian vs ψ-Corrected Force

# simulations/phase11\_part3\_force\_deviations.py  
import numpy as np  
import matplotlib.pyplot as plt  
  
# Parameters  
r = np.linspace(1, 50, 500)  
G, m1, m2 = 1.0, 1.0, 1.0  
  
# Newtonian force  
F\_newton = G \* m1 \* m2 / r\*\*2  
  
# ψ-gradient correction (exponential profile)  
psi\_grad = np.exp(-0.05 \* r) # decaying ψ  
deltaF\_psi = -0.2 \* psi\_grad / r  
  
# Current² correction (oscillatory)  
deltaF\_current = 0.1 \* np.sin(0.3 \* r) / r\*\*2  
  
# Total ψ-gravity force  
F\_total = F\_newton + deltaF\_psi + deltaF\_current  
  
# Plot  
plt.figure(figsize=(8, 5))  
plt.plot(r, F\_newton, label="Newtonian 1/r²")  
plt.plot(r, F\_total, label="ψ-gravity corrected")  
plt.plot(r, deltaF\_psi, '--', label="ΔF\_ψ")  
plt.plot(r, deltaF\_current, ':', label="ΔF\_current")  
plt.xlabel("r")  
plt.ylabel("Force")  
plt.title("Phase 11 – Part 3: Deviations from Newtonian Behavior")  
plt.legend()  
plt.grid(True)  
plt.show()