

Unified Action (Master Equation)

The total action is composed of four main parts: gravity, matter, gauge fields, and quantum corrections.

$$S = S_{\text{gravity}} + S_{\text{matter}} + S_{\text{gauge}} + S_{\text{quantum}}$$

Components

Gravity Action

The Einstein-Hilbert action describes classical gravity in terms of spacetime curvature.

$$S_{\text{gravity}} = \frac{1}{16\pi G} \int d^4x \sqrt{-g} (R - \frac{2\Lambda}{2})$$

Matter Action

The Dirac action describes fermions (matter particles) in curved spacetime.

$$S_{\text{matter}} = \int d^4x \sqrt{-g} \bar{\psi} (i \gamma^\mu D_\mu - m) \psi$$