Unified Action (Master Equation)

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

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

Components

Gravity Action

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

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

Matter Action

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

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