Gravitational Waves in the Interaction theory of Gravitation

Langa Horoto

October 2026

Abstract

We formulate gravitation as an interaction theory in which the fundamental quantities are Noether currents associated with spacetime translations, rather than the spacetime metric. We first show that identifying geodesic motion with force-free motion requires an additional assumption concerning the inertial character of locally Minkowskian frames. We therefore define physical force through the failure of translations to yield conserved momentum currents. This definition is invariant under arbitrary coordinate transformations and leads to a natural separation of gravitational and nongravitational force densities. The gravitational potentials are identified with the one-forms dual to the translation-generating vector fields. Requiring force-density balance then yields nonlinear gravitational field equations, with the self-interaction of the translation fields generating a structure analogous to that of gauge theories. Translation charges provide a unified expression for gravitational energy, whose boundary contribution reproduces the Arnowitt–Deser–Misner energy for asymptotically flat configurations while extending to more general boundary conditions. We study the gravitational waves in this formulation.