

# Chapter 1

## Physics

### 1.1 What is physics?

Physics is the science that studies the fundamental laws of nature.

### 1.2 Overview of physics

See Figure 1.2.1.

**Newtonian mechanics** Everyday physics. See Chapter 2: Classical mechanics.

**Electrostatics** Non-relativistic electric interactions. See Chapter 2: Classical mechanics.

**Newtonian gravity** See Chapter 2: Classical mechanics.

**Special relativity** Unifies space and time. See Chapter 2: Classical mechanics.

**Electrodynamics** Unifies electric and magnetic interactions into a relativistic theory of a dynamical electric field. See Physics II.

**General relativity** Theory of dynamical spacetime with spacetime curvature  $\equiv$  gravity.

**Quantum mechanics** Quantum theory of particles. See Physics II.

**Quantum field theory** Unifies particles and fields.

**Standard Model** The particular realization of quantum field theory in our neighbourhood of the universe. Composed of strong (nuclear), electroweak, quark, lepton (electron, etc) and Higgs quantum fields.

**String theory** The presumed theory of everything, unifying quantum field theory and general relativity. Started as a quantum theory of strings but has grown into something more general but not yet fundamentally understood.

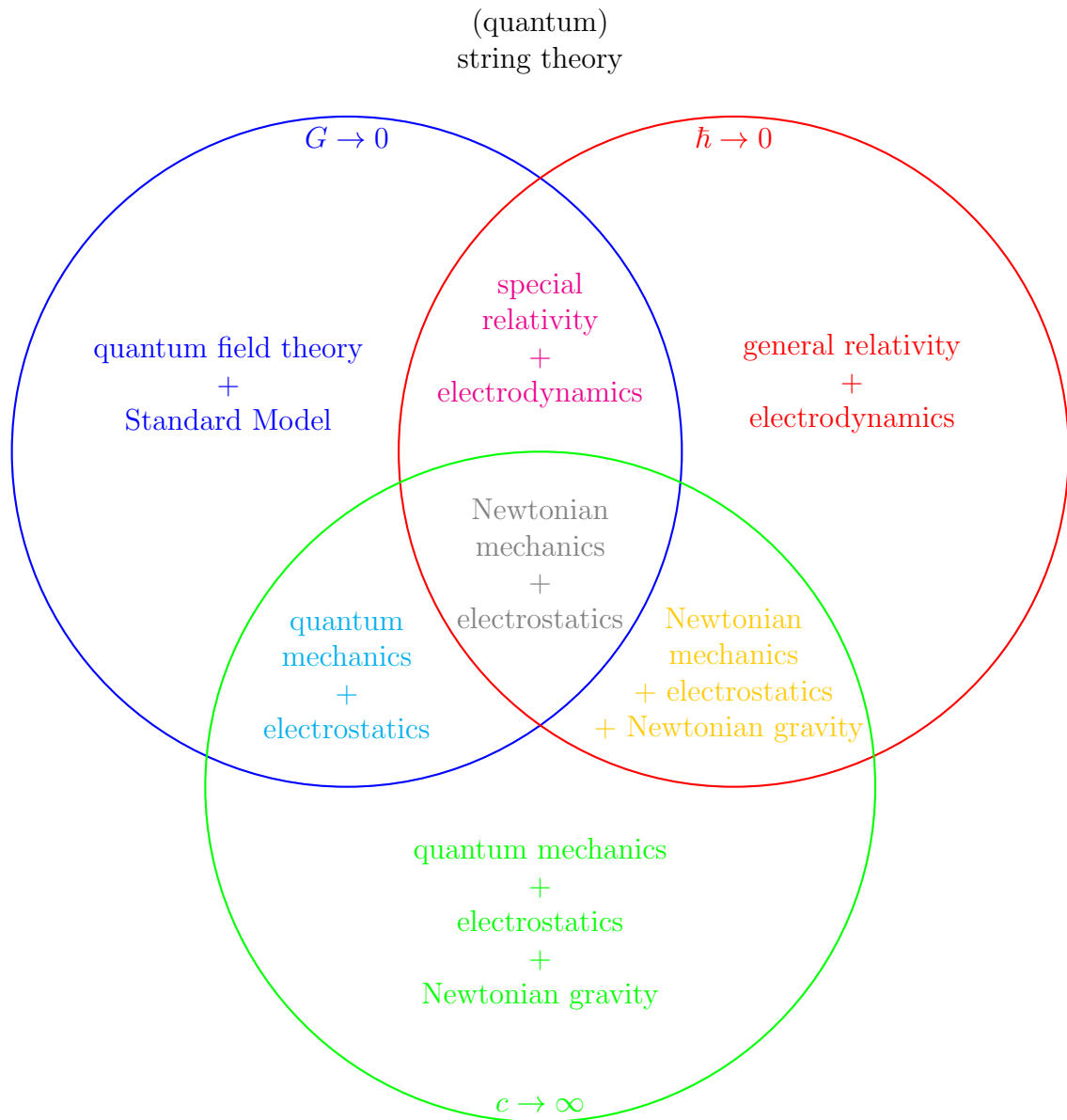


Figure 1.2.1: Physics as a function of the fundamental physical scales: Planck's constant  $\hbar \simeq 1 \times 10^{-34} \text{ kg m}^2 \text{ s}^{-1}$ , speed of light  $c \simeq 3 \times 10^8 \text{ m s}^{-1}$ , gravitational constant  $8\pi G \simeq 2 \times 10^{-9} \text{ kg}^{-1} \text{ m}^3 \text{ s}^{-2} \simeq 20 M_{\oplus}^{-1} A_{\oplus} \text{ m s}^{-2}$ , where  $M_{\oplus}$  and  $A_{\oplus}$  are the mass and surface area of the Earth respectively.