# Exploring fundamental physics with neutron stars

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In this lecture, we give a first introduction to neutron stars, based on fundamental physical principles. After outlining their amazing macroscopic properties, as obtained from observations, we infer the extreme conditions of matter in their interiors. We then describe two crucial physical phenomena which characterize compact stars, gravitational stability of strongly degenerate matter and neutronization of nuclear matter with increasing density, and explain how the formation and properties of neutron stars are a consequence of the extreme compression of matter under gravity. Finally, we describe how astronomical observations of various external macroscopic features can give invaluable information about the exotic microscopic scenario inside: neutrons stars represent a unique probe to study super-dense, isospin-asymmetric, superfluid, bulk hadronic matter. In particular, we consider mass measurements in general relativistic binary systems, cooling observations, pulsar glitches and emission of gravitational waves as examples of how neutron stars can shed light on the quantum properties of strongly degenerate matter and on the geometry of space-time.