

Very compact objects probe extreme gravitational fields and may be the key to understand outstanding puzzles in fundamental physics, from the nature of dark matter, to the fate of spacetime singularities and the loss of unitarity in Hawking evaporation. The standard astrophysical description of collapsing objects tells us that all massive, dark and compact objects are black holes. Any observation suggesting otherwise would be a smoking gun from new physics. The advent of gravitational-wave astronomy and precise measurements with very long baseline interferometry allow one to finally probe into such foundational issues. We overview the physics of exotic compact objects, their peculiar signatures, and their observational status, including the experimental evidence for black holes with current and future experiments.