Binary neutron stars: Einstein's richest laboratory

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If black holes represent one of the most fascinating implications of Einstein's theory of gravity, neutron stars in binary system are arguably its richest laboratory, where gravity blends with astrophysics and particle physics. I will discuss the rapid recent progress made in modelling these systems and show how the inspiral and merger of a binary system of neutron stars is more than a strong source of gravitational waves. Indeed, while the gravitational signal can provide tight constraints on the equation of state for matter at nuclear densities, the formation of a black-hole--torus system can explain much of the phenomenology of short gamma-ray bursts, while the ejection of matter during the merger can shed light on the chemical enrichment of the universe. Finally, I will review how our understanding on the maximum mass and radii of neutron stars has improved with the detection of GW170817.