Multi-messenger signals of gravitational wave sources (MINOTAUR)

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Abstract

Binary systems of two neutron stars involves physics under the extreme conditions: they are made of the densest form of matter in the Universe and as they revolve around each other they dynamically "warp" the spacetime and thereby emit gravitational waves which drives them to a final catastrophic collision. During this encounter, temperatures in excess of 10^{11} K are reached (for comparison: the core of our Sun is at 1.5×10^7 K) and the resulting object can –promptly or in a delayed fashion– collapse into a black hole. During the collision neutron star matter is ejected into space and this can lead to a number of potentially observable signals.

The aim of this project is to understand the various physical processes that occur in such a merger and to predict how they manifest themselves in observational signatures. Questions at the focus of this proposal include: What is the origin of the heaviest elements in the Universe and to which extent do compact object mergers contribute? What can we learn from gravitational waves about the most extreme (densest and hottest) matter states in the Universe? How are the most luminous explosions in the Universe, gamma-ray bursts, produced?