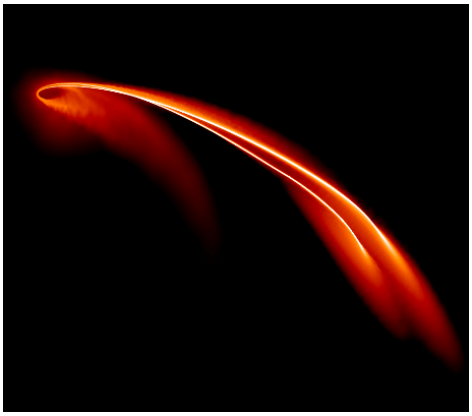
Short description of the HLRN project

Multi-Messenger Signals from Compact Objects

Prof. Dr. Claus Lämmerzahl
Center for Applied Space Technology and Microgravity
University Bremen
Am Fallturm
28359 Bremen, Germany

and

Prof. Dr. Stephan Rosswog
Astronomy and Oskar Klein Centre
Stockholm University, AlbaNova
SE-106 91 Stockholm, Sweden



Abstract

The era of gravitational wave astronomy has begun on September 14 2015 with the first direct detection of the merger of two black holes. On August 17 2017 the first binary neutron star merger ever was detected, both in gravitational waves and across the whole electromagnetic spectrum. The discovery detector, the advanced LIGO interferometer, has just been complemented by VIRGO and more detector facilities will follow, among them the space-based LISA mission. The major target of gravitational wave astronomy are compact objects such as black holes, neutron stars and white dwarfs. Catastrophic events involving compact objects produce –apart from gravitational waves– also energetic emission in other channels such as neutrinos or electromagnetic waves. These additional channels are crucial for localizing events in the sky, for understanding their astronomical environment, for constraining the progenitor evolution and for understanding the non-gravitational physics of the source. The prediction of these multi-messenger signals is the major goal of this proposal.

1. Project Summary

The aim of this project is to understand various aspects (hydrodynamics, gravity, neutrino emission, nucleosynthesis, electromagnetic transients) in catastrophic events involving compact objects such as black holes and neutron stars. Of particular scientific interest for the first phase of the project are:

- The neutrino-driven winds that emerge from the remnant of a neutron star merger. They are crucial for the question whether the ultra-relativistic outflow needed for a gamma-ray burst can emerge, for cosmic nucleosynthesis and for resulting electromagnetic transients.

- Tidal disruptions of stars by massive black holes. Here we are particularly interested in the dynamical evolution of the disruption, its observational consequences and the role of the involved black hole (mass and spin).

Apart from these starting points there is a large number exciting questions related to gravitational wave/multi-messenger astrophysics that are to be addressed in the near future.