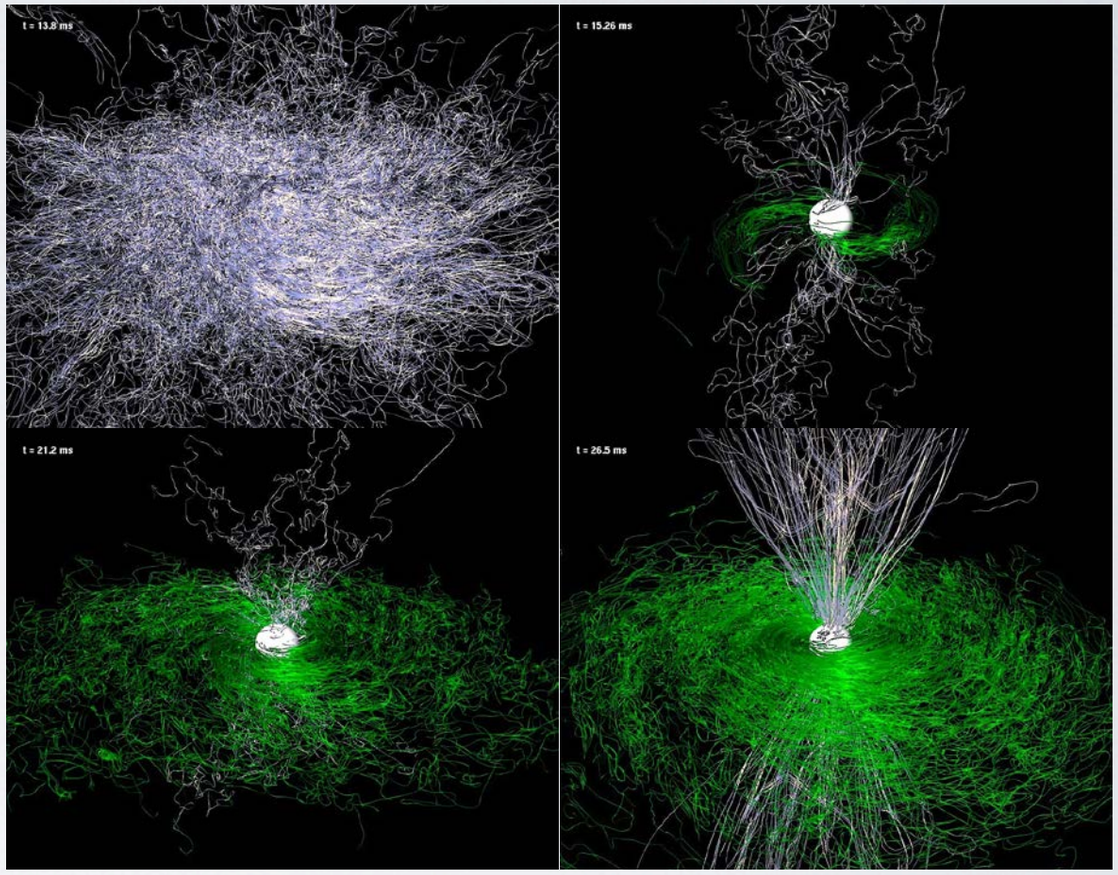
General-relativistic magneto-hydrodynamics simulations of binary compact-star mergers

Luca Baiotti, Institute of Laser Engineering, Osaka University

Binary neutron stars are good sources for gravitational-wave detectors such as KAGRA (http://gwcenter.icrr.u-tokyo.ac.jp/en/). Binary neutron-star mergers are also possible sources of short gamma-ray bursts (GRBs).
Accretion discs formed after the merger could power GRBs via neutrinos and/or magnetic fields.

With our code "Whisky", we perform 3-dimensional simulations of binary neutron-star mergers on consistent time-varying spacetimes. Our code solves the Einstein equations of general relativity together with the relativistic magneto-hydrodynamics equations.



Some results of our simulations are presented in the figures, which show the magnetic-field lines (white lines in the equatorial plane and green lines outside the disc) at selected times.
At the merger the magnetic field is amplified through Kelvin-Helmholtz instability and grows of one order of magnitude. Because of this exponential growth, the final value of the magnetic field is largely insensitive to the initial strength and thus a robust feature of the dynamics.
The hollow jet-like magnetic structure has an opening half-angle of about 30°, which sets an upper limit for the opening half-angle of any potential outflow, either produced by neutrino energy deposition or by electromagnetic processes.