GRMHD Simulation of Binary Neutron Star Merger and the Mixing of Kilonova Ejecta

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Binary neutron star (BNS) merger is rich in fundamental physics with GW signals and electro-magnetic(EM) counterparts, and it is believed to be the main source of making r-process elements, whose radiative decay power the kilonovae.

We present 3D GRMHD simulations of BNS and the comparison of different evolution methods with various initial setups by using a full GR code, Einsteintoolkit . We found the simulation without consideration of magnetic field emits more unbound outflow and the merger gravitational wave signal can be detected by LIGO if the merger site is shorter than 5 Mpc. For making predictions for future observations, we extend our simulations by using FLASH to produce synthetic observations of the kilonovae.

In order to investigate the ejcta of nuclear heating from the decay of r-process elements on the outflow. We perform the local mixing of kilonova ejecta with 2-layer model in different situations. The relation of instability merging rate and different physical variables such as velocity, heating rate, density and temperature is present.

On conclusion, both the universal view of BNS and local view of mixing of ejecta are investgated. Testing various types of mixing with at physical scale is worth of future exploration.

Keywords: Binary Neutron Star, Kilonova, Instability