Kilonovae/Macronovae from Black-hole Neutron star Mergers

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Ref: K. Kawaguchi, K. Kyutoku, M Shibata, M Tanaka., ApJ., 2016

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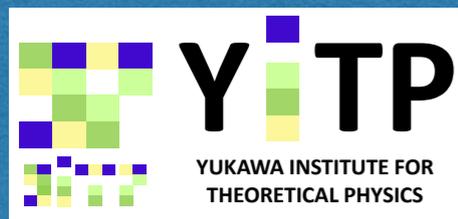
Compact Stars and Gravitational Waves

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Kilonovae / macronovae

- **Black hole -neutron star binary mergers** are among the most promising targets for ground-based gravitational-wave detectors. The simultaneous detection of electromagnetic counterparts with the gravitational-wave detection enhances scientific returns from each merger event.

- A fraction of the NS material would be **ejected** during the NS-NS or BH-NS merger. Since the NS consists of highly neutron-rich matter, **r-process nucleosynthesis** is expected to take place in the ejecta.

- **Kilonova/macronova**—the emission powered by decay of the radioactive nuclei would occur.
  (Li & Paczynski 1978)

- Many **numerical relativity (NR) simulation** have been performed in a wide range of binary parameters, and the quantitative dependance of the properties of the ejecta is becoming clear.
  (e.g., KK et al. 2015, Kyutoku et al. 2015, Foucart 2014, Lovelace et al. 2013)

- To discuss the observability of kilonovae/macronovae, **multi-frequency radiation transfer (RT) simulations** based on NR results
  (Roberts 2011, Kasen 2013, Tanaka et al. 2013)

Mass ejection from a black-hole-neutron star merger
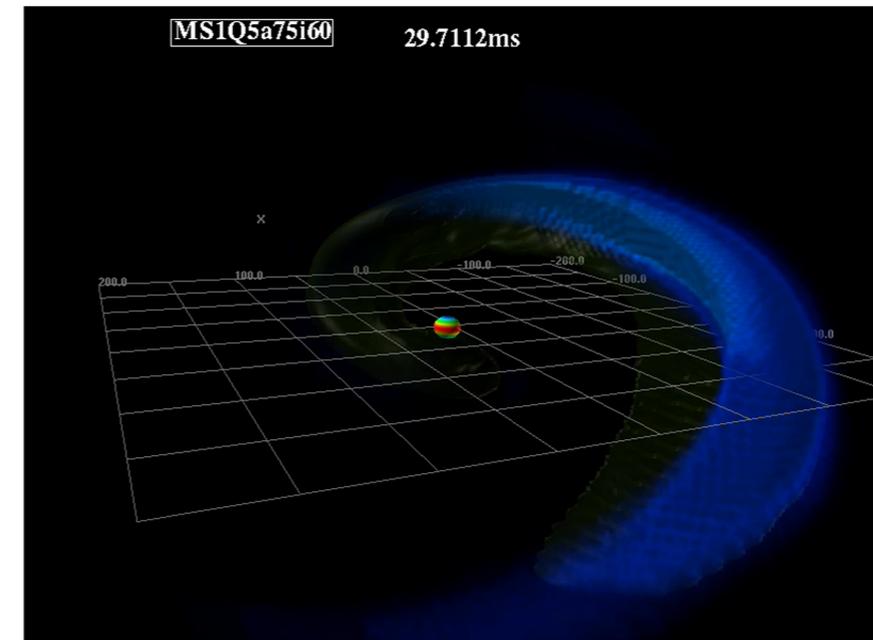
Ref: K. Kawaguchi et. al 2015

Radiative transfer simulation of BHNS kilonova/macronova

Ref: M. Tanaka et. al 2014
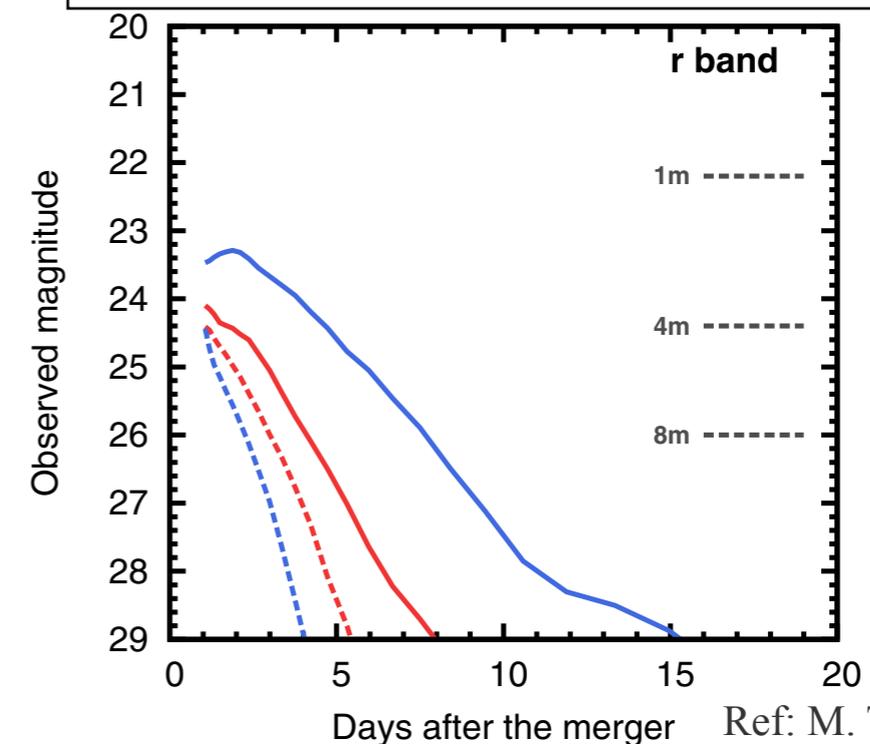
Parameter study of BHNS kilonovae/macronovae

- The parameter study of BH-NS kilonovae/macronovae on the binary parameters are not yet enough since NR simulations and RT simulations are still computationally expensive.

- To discuss the dependence and the observability of kilonovae/macronovae from the BH-NS mergers in wide range of binary parameter, we construct

  - i) mass and velocity fitting formulae for the ejecta from BH-NS mergers.

  - ii) an analytic light curve model of kilonovae/macronovae.

- We calibrate and check the validity of those models by making comparisons with the results of NR simulations and RT simulations.
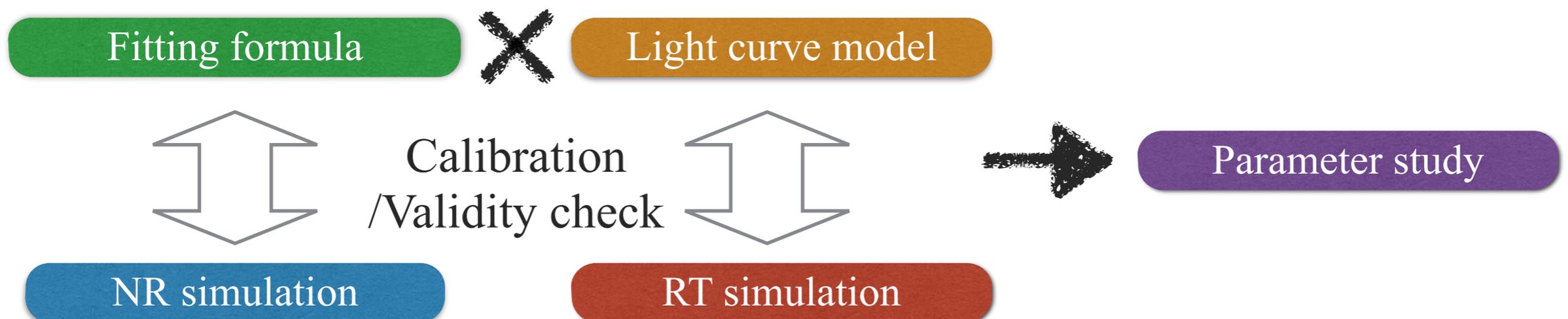
Please come and see my poster for the details and the results!