Contribution ID: **77** Type: **Oral contribution**

Semi-analytic modeling of kilonovae with the radiative transfer equations

Wednesday, September 28, 2022 12:25 PM (5 minutes)

Matter expelled from binary neutron star (BNS) and black hole-neutron star (BHNS) mergers is one confirmed site capable of harboring r-process nucleosynthesis in the universe, due to its extreme conditions and abundance of neutrons. The freshly produced nuclei are unstable and undergo nuclear decay, releasing an amount of energy sufficient to power a thermal transient known as kilonova (KN). A kilonova shines from a few hours ("blue" KN) to a few weeks ("red" KN) after merger and represents a major electromagnetic counterpart to gravitational wave signals.

We start from an analytic solution of the radiative transfer equations to develop a NR informed kilonova model which considers multiple ejecta components, the general anisotropy of their dynamical properties and the projection in the observer viewing direction. We propose an ejecta structure such that the total luminosity is the combination of two contributions, one emitted at the photosphere, delimiting the optically thick bulk of the ejecta, and one coming from the optically thin layers outside of it. The impact of the ejecta thermodynamical properties on the light curves is explored by employing parametrized radioactive heating rates derived from nuclear reaction network calculations. We validate our model by comparing our results with multy-frequency radiative transfer simulations, pointing out the improvements with respect to other simpler semi-analytic models.

Primary author: Mr RICIGLIANO, Giacomo (Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 2, 64289 Darmstadt, Germany)

Co-authors: Mr LIPPOLD, Lukas Chris (Theoretisch-Physikalisches Institut, Friedrich-Schiller Universität Jena, 07743 Jena, Germany); Prof. PEREGO, Albino (Dipartimento di Fisica, Università di Trento, Via Sommarive 14, 38123 Trento, Italy); Prof. ARCONES, Almudena (Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 2, 64289 Darmstadt, Germany)

Presenter: Mr RICIGLIANO, Giacomo (Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 2, 64289 Darmstadt, Germany)

Session Classification: Session 5