Contribution ID: **61** Type: **not specified**

Numerical and experimental investigations on compact binary ejecta plasma opacity relevant for kilonova transient signals

Monday, 9 May 2022 10:35 (20 minutes)

Joint observations of gravitational-wave (GW) event to compact binary objects mergers, and of their electromagnetic counterpart, known as kilonova (KN) can provide a new avenue in the framework of the multi-messenger astronomy to constrain the astrophysical origin of the *r*-process elements and the equation of state of dense nuclear matter [1]. Coalescence of double neutron star releases neutron-rich ejecta which undergo *r*-process nucleosynthesis, with subsequent quick evolution of the KN thermal transient fed by radioactive decays of unstable nuclei. KN acts as spectral diagnostic to probe physical conditions and composition during the merger and aftermath, therefore is of fundamental relevance for future detection and for providing sounder nucleosynthetic yields occurring in these loci [2]. Largely heterogeneous post-merging ejecta composition made of both light and heavy-*r* process nuclei implies strong effects on the KN light-curve identification due to the varying opacity of the system. Hence, large uncertainties on the r-process nucleosynthesis final abundance from the spectroscopic analysis of the KN signal are still present, hardly fixed by theoretical models. Here we report on the current paradigm of early-stage timescale KN emission at optical wavelengths from light *r*-process ejecta component, and we present the work carried out in the framework of the PANDORA collaboration [3] to support planned experimental measurements of plasma opacity with in-laboratory plasmas resembling these KN-stage conditions [4]. In this view, the results of recently performed experiments at the LNS on the Flexible Plasma Trap (FPT) to reproduce suitable early-stage ejecta conditions for the designed first-of-its-kind opacity measurements of under-dense and low-temperature plasmas are here reported.

[1] Rosswog S. The multi-messenger picture of compact binary mergers. *International Journal of Modern Physics D24(2015) 1530012.*

[2] Kasen D., et al. Origin of the heavy elements in binary neutron-star mergers from a gravitational-wave event. *Nature551(2017) 80–84.*

[3] Mascali D., et al. A novel approach to beta-decay: Pandora, a new experimental setup for future in-plasma measurements. *Universe8(2022).*

[4] Pidatella A., et al. In-plasma study of opacity relevant for compact binary ejecta. *Il Nuovo Cimento C44(2021) 4.*

Primary author: Dr PIDATELLA, Angelo (Istituto Nazionale di Fisica Nucleare - Laboratori Nazionali del Sud)

Presenter: Dr PIDATELLA, Angelo (Istituto Nazionale di Fisica Nucleare - Laboratori Nazionali del Sud)

Session Classification: Astrofisica nucleare I