Contribution ID : **249** Type : **Oral talk**

Nucleosynthesis in the crust of minimal mass neutron star. Stripping model.

Wednesday, 23 October 2024 17:24 (12)

The discovery of lanthanides traces in the kilonova spectra after recording a gamma-ray burst and gravitational waves [1] confirmed theoretical scenarios for the development of the r-process [2], associated with the neutron stars merger at the end of a close binary system evolution. After successful r-process simulation that occurs as a result of the neutron stars merger and observing these events, it became clear that this scenario is crucial for the heaviest nuclei formation. However, the neutron stars evolution in close binary systems strongly depends on their masses. With a large neutron stars masses difference, a stripping scenario is implemented instead of merging [3], which, in particular, has different heavy elements nucleosynthesis path [4,5].

In this work the nucleosynthesis in the low-mass neutron star crust, which loses mass due to accretion onto a larger companion and explodes upon reaching a hydrodynamically unstable configuration [3] is considered.

It was shown that in the stripping scenario the exploded residue substance expands and, while its density is high, new elements nucleosynthesis occurs. In the inner crust it originates mainly due to the r-process. Nucleosynthesis in the outer crust occurs mainly due to explosive nucleosynthesis following sharp increase in temperature caused by a shock wave, and forms significant number of light nuclei. A simple model of subnuclear dense matter decompression is proposed. The amount of heavy elements formed in a neutron star crust is M ˜ 0.04MΘ, which is at least an order of magnitude greater than the yield of heavy elements in the close masses neutron stars mergering scenario [6].

The work was carried out within the state assignment framework of the National Research Center «Kurchatov Institute».

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Session Classification : Astroparticle

Track Classification : Astroparticle physics