Contribution ID : **111** Type : **oral contribution**

Nuclear structure and dynamics of the GDR at low temperatures and its influence in the universal abundance of elements

Thursday, 30 May 2024 12:00 (30)

Astronomical observations indicate that the abundances of heavy elements from barium to lead in metal-poor stars are consistent with the scaled Solar system abundance pattern for the rapid-neutron capture or r-process, where 50% of the heavy elements beyond iron are expected to be produced in stellar explosions such as neutron star mergers. Given that the Sun formed billions of years after these metal-poor stars, from gas that was enriched by many stellar generations in various ways, such an astounding agreement suggests that the way these elements are produced is universal [1-3]. The origin of such an universal abundance pattern was obscured with a couple of scenarios being suggested: 1) An artifact of nuclear properties such as binding energies and β-decay rates. 2) A single cosmic site with astrophysical conditions that are generated uniformly throughout cosmic time. Here we provide a solution to the universal composition of matter through the decreasing binding energy of nuclei at the temperatures occurring in stellar explosions, which arise from a slight increase in the energy of the giant dipole resonance (GDR), a collective motion of protons and neutrons out of phase, which is responsible for the most of the absorption of photons in nuclei and the nuclear dipole polarization. Such changes narrow down the reaction network for element production in stellar explosions, and explain the long-sought universality of elemental abundances [4].

[1] Frebel, Annu. Rev. Nucl. Part. Sci. 68 (2018) 237

[2] Sneden, Cowan, and Gallino, Ann. Rev. Astron. Astrophys. 46 (2008) 241

[3] Ji, Frebel, Chiti et al. Nature 531 (2016) 610

[4] Orce et al., MNRAS 525 (2023) 6249

Primary author(s) : JOSE NICOLAS ORCE (University of the Western Cape, South Africa)

Presenter(s) : JOSE NICOLAS ORCE (University of the Western Cape, South Africa)

Session Classification : Session 12