Contribution ID: **4** Type: **Oral presentation**

Production of p-nuclides in accreting neutron star common envelopes

Friday 18 October 2024 10:00 (20 minutes)

In massive-star binary systems, upon reaching later stages of stellar evolution one star can expand as a giant and envelope its companion in what is called a common envelope phase. The enveloped companion, here a neutron star, begins to accrete matter. The angular momentum of the accreting material results in the formation of an accretion disk. Accretion of hydrogen rich onto common-envelope-phase neutron stars can result in material ejected from the accretion disk having undergone burning near the neutron star's surface [1]. Not much is understood about what nucleosynthesis occurs in this system. However, Keegans et al. (2019) found that accreting neutron star common envelopes have the potential to impact galactic chemical evolution (GCE) [1].

Our preliminary results show that this astrophysical scenario can produce large amounts of light p-nuclides 92Mo, 96Ru and 98Ru - upwards of one order of magnitude more than their initial abundances in our simulations. This is significant as these isotopes are all underproduced in current p-process models and their origins are not known [2, 3].

The presented work builds on Keegans et al. (2019), which modelled accreting neutron star common envelopes without the inclusion of angular momentum, and Abrahams et al. (2023), which presented initial results on updated models which included the impact of angular momentum [1,4]. We will present yields from our common envelope simulations and discuss the nucleosynthesis which leads to high production of particular light p-nuclides.

[1] Keegans J., Fryer C.L., Jones S.W., Côte B., Belczynski K., Herwig F., Pignatari M., et al., 2019, MNRAS, 485, 620. doi:10.1093/mnras/stz368

[2] Roberti L., Pignatari M., Psaltis A., Sieverding A., Mohr P., Fulop Z., Lugaro M., 2023, A&A, 677, A22. doi:10.1051/0004-6361/202346556

[3] Travaglio C., Rauscher T., Heger A., Pignatari M., West C., 2018, ApJ, 854, 18. doi:10.3847/1538-4357/aaa4f7

[4] Abrahams S.E.D., Fryer C., Hall-Smith A, Laird A.M., Diget C., 2023, EPJWC, 279, 10002. doi:10.1051/epjconf/202327910002

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Stellar Models and Galactic Chemical Evolution

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Session Classification: Morning session