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Heavy Elements Nucleosynthesis On Accreting White Dwarfs surface: seeding the the p-process

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The production of the proton-rich isotopes beyond iron that we observe today in the solar system is still uncertain. Thermonuclear supernovae (SNe Ia) exploding within the single-degenerate scenario have been proposed to be a potential source for these isotopes. Recent works studying the p -process production in SNe Ia assume s -process rich pre-explosive seeds, built by neutron captures in the external layers of the progenitor, during the accretion phase. Presently there are no complete stellar models calculating these abudances, covering the WD mass range up to the Chandrasekhar mass. We calculate accretion models for five white dwarfs (WDs) with different initial masses (0.85, 1, 1.26, 1.32, 1.38 solar masses) using the stellar code MESA. We then focus on the nucleosynthesis of the 1, 1.26, 1.32 and 1.38 solar masses models, calculating the full abundance distribution. In our models the dominant neutron source are the 22Ne(α,n)25Mg, which is activated at the bottom of the convective thermal pulse driven by the He flashes along the accretion phase, for WD masses lower than 1.26 solar masses, and the 13C(α ,n)16O for WD masses equal or higher than 1.26 solar masses. We found neutron densities up to few 10^15 cm^−3 in the most massive WDs. In particular, the neutron density and the total production of neutrons increase with increasing mass of the accreting WD. The abundance distribution peaks between Fe and Zr for the models at M = 0.85 and 1 solar masses, while for larger WDs much higher production efficiency is obtained beyond iron, with a strong production up to the Pb region. Using these results, we compute the nucleosynthesis of proton rich heavy isotopes using a multi-D SNe Ia model, and discuss the uncertainties affecting our results. Finally, the frequency of the single-degenerate scenario channel to produce SNIa is controversial. The impact on the p-process production in this scenario is also discussed.

Primary author: BATTINO, Umberto (University of Edinburgh)

Co-authors: LEDERER-WOODS, Claudia (University of Edinburgh); TRAVAGLIO, Claudia (INFN Torino); PIGNATARI, Marco (University of Hull)

Presenter: BATTINO, Umberto (University of Edinburgh)

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