The 13th Torino Workshop on AGB stars & the 3rd Perugia Workshop on Nuclear Astrophysics

Contribution ID: **13** Type: **Oral (in presence)**

Production of light trans-Fe elements in neutrino-driven winds of core-collapse supernovae: Implications from presolar SiC-X grains

Wednesday, 22 June 2022 16:35 (25 minutes)

In a large-scale nucleosynthesis parameter study, we have extended the initial ideas of Hoffman et al. [1], who showed that light p-nuclei can be produced in the neutrino-driven winds of core-collapse supernovae (cc-SNe). Our project began about a decay ago, based on the r-process model of Farouqi et al. [2], where we found that in the low-entropy (S) charged-particle component of moderately neutron-rich wind ejecta of cc-SNe, in addition to the classical light „p-only“isotopes, the „s-only“and „r-only“nuclei between Zn (Z = 30) and Pd (Z = 46) can also be co-produced [3,4]. In the present contribution, we focus on a recent update to the nucleosynthetic interpretation of the anomalous isotopic compositions of Zr (Z = 40; 5 stable isotopes), Mo (Z = 42; 7 stable isotopes) and Ru (Z= 44; 7 stable isotopes) reported in the rare presolar SiC-X grains discovered by the Argonne/Chicago group [5]. In contrast to the dominant class of AGB (s-process) grains, very few SiC-X grains were identified and qualitatively interpreted to originate from explosive nucleosynthesis scenarios. We show that these meteoritic observations do not represent the signatures of a „clean“stellar scenario, but rather are mixtures of an exotic nucleosynthesis component with different fractions of Solar System material [6,7]. The co-production of these isotopes through a rapid „primary“production mode provides further means to revise the abundance estimates of the light trans-Fe elements from so far favoured „secondary“nucleosynthesis scenarios like Type Ia SNe (see, e.g. [8]) or neutron-bursts in exploding massive stars [9]. Finally, we point out that from the isotopic abundance patterns of the SiC-X grains, we obtain better electron fraction - entropy ($Y_e - S$) constraints for nucleosynthesis in regular cc-SNe nucleosynthesis than we do from the elemental abundances of metal-poor halo stars [10].

References:

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Session

Dust and presolar grains

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Session Classification: Dust and presolar grains