On the Origin of the Early Solar System Radioactivities. Problems with the AGB and Massive Star Scenarios

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Recent improvements in stellar models for intermediate-mass and massive stars are recalled, together with their expectations for the production of radioactive nuclei with lifetime $\tau \lesssim 25$ Myr, in order to re-examine the origins of now extinct radioactivities, found to be alive in the Early Solar System [1, 2]. While the inheritance from Galactic evolution broadly explains the concentrations of most of them [2], ^{26}Al, ^{56}Fe, ^{41}Ca and ^{135}Cs require one or more nucleosynthesis events occured close in time and space to the solar formation. We outline the difficulties to account for the required nuclei by Asymptotic Giant Branch stars. Recent physical models predict the ubiquitous formation of a ^{13}C reservoir as a source for efficient neutron captures [3, 4, 5, 6]. As a consequence, even in presence of ^{26}Al production from Deep Mixing or Hot Bottom Burning, the foreseen ratio ^{26}Al/^{107}Pd remains incompatible with the measured data, due to a large excess in ^{107}Pd. This is shown with reference to two different approaches to Deep Mixing. Instead, recent revisions invoking specific supernovae of relatively low mass and/or scenarios for the sequential contamination of the pre-solar molecular cloud [7, 8] would most probably induce a huge excess on ^{60}Fe and unacceptaly high excesses on stable isotopes. The limited parameter space remaining to be explored for solving this puzzle is discussed.

References

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