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Nitrogen isotopic ratio across the Galaxy through observations of high-mass star-forming cores

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Abstract. There is a growing evidence that our Sun was born in a rich cluster that also contained massive stars. Therefore, the study of high-mass star-forming regions is key to understand our chemical heritage. In fact, molecules found in comets, in other pristine Solar System bodies and in protoplanetary disks, are enriched in ^{15}N, because they show a lower ^{14}N/^{15}N ratio (100-150) with respect to the value representative of the Proto-Solar Nebula (PSN, 441±6), but the reasons of this enrichment cannot be explained by current chemical models. Moreover, the ^{14}N/^{15}N ratio is important because from it we can learn more about the stellar nucleosynthesis processes that produces both the elements. In this sense observations of star-forming regions are useful to constrain Galactic chemical evolution (GCE) models.

Keywords. ISM: abundances, Galaxy: evolution, nucleosynthesis

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We have derived the ^{14}N/^{15}N ratio in a sample of 87 high-mass star-forming cores, from observations of HCN(1-0) and HNC(1-0), observed with the IRAM-30m telescope (Colzi *et al.* 2018a and Colzi *et al.* 2018b) and we have found that the ratio spans the range 100-1000, with most of the sources (25%) having values in the range 310 ¡ ^{14}N/^{15}N ¡ 350 (see Fig. 2 in Colzi *et al.* 2018b), namely below the PSN value and just above the terrestrial atmosphere (TA) value (272). The abundance ratio ^{14}N/^{15}N is also considered a good indicator of stellar nucleosynthesis. Both isotopes have indeed an important secondary production in the CNO cycles. There is the cold CNO cycle that takes place in main-sequence stars and in the H-burning shells of red giants, and the hot CNO cycle, that occurs instead in novae outbursts and is the main way to produce ^{15}N. However, there is also a strong primary component of ^{14}N created in the Hot Bottom Burning (HBB) of asymptotic giant branch (AGB) stars. These differences lead to an increase of ^{14}N/^{15}N ratio with the Galactocentric distance (D_{GC}), up to 8 kpc, as predicted by models of GCE (e.g. Romano *et al.* 2017). However, the relative importance of these processes is still unclear. The only way to test this is to provide more observational contraints. The 87 dense cores that we have observed span D_{GC} in the range 212 kpc, and we have obtained a new Galactocentric trend of ^{14}N/^{15}N. The GCE model is able to reproduce this trend (see Fig. 6 in Colzi *et al.* 2018b).

References

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