Production of Left-handed Amino Acids in Space in the Supernova Neutrino Amino Acid Processing (SNAAP) Model

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The ability of the Supernova Neutrino Amino Acid Processing (SNAAP) model to produce enantiomeric amino acids in space has been studied in detail [1]. This model uses the magnetic field from a source object such as a neutron star, along with the Lorentz force electric field from the motion of objects in the magnetic field, to distinguish between the two chiral states of amino acids. Then the electron antineutrinos from a neutron star or a supernova selectively destroy one chirality, producing enantiomeric amino acids in nearby meteoroids.

In the present paper, several possible sites that could produce the requisite conditions for the SNAAP model were studied to determine their viability for processing meteoroids so as to produce left-handed favoring amino acids. Several sites appear to provide the requisite magnetic field intensities and electron anti-neutrino fluxes, although other factors constrain their viability.

Perhaps the most obvious site would be a core-collapse supernova; they produce both a strong magnetic field and an intense electron antineutrino flux. However, this site alone cannot serve as the SNAAP model source. The magnetic field from the nascent neutron star when the supernova occurs was found to be effective out to only about 1 percent of an A.U., while the star would expand to about 100 times that radius when it entered its red giant phase, surely cooking any preexisting amino acids, and preventing any new ones from being made.

A more likely candidate is a close binary system consisting of a neutron star and a massive star. The latter would shed its outer one or two layers to form an accretion disk around the neutron star, converting the massive star to a Wolf-Rayet star, circumventing the red giant expansion of the massive star. The dense matter in the accretion disk is thought to develop into dust grains, meteoroids, and even planets, and amino acids could be created in these objects as they formed in the outer layers of the disk. The magnetic field necessary for the SNAAP model would result from the neutron star. Electron antineutrinos might be provided over long periods of time from the neutron star, but might also occur from the burst that would be produced when the WR star became Type Ib or Ic supernova. Other possible candidates, e.g., merging neutron stars, were also studied, but have larger parameter uncertainties.

A recent paper [2] suggests, from the local ^{26}Al abundance, that the Solar System was formed from a WR star. While this isn't exactly the binary system that we concluded was necessary for the SNAAP model, the needs of the SNAAP model do not preclude the WR star that study concludes formed the Solar System. Furthermore, similarities are sufficiently striking to conclude that this second paper might serve to confirm, at some level, the SNAAP model.

These results have obvious implications for the origin of life on Earth.

References

[1] Famiano, M. A., et al.: 2018, *Astrobiology*, **18**, 190.
[2] Dwarkadas, V. V., et al.: 2017, *ApJ*, **851**, 147.