ISOTOPE SELECTIVE PHOTODISSOCIATION OF N_2 BY THE INTERSTELLAR RADIATION FIELD AND COSMIC RAYS

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Photodissociation of $^{14}N_2$ and $^{14}N^{15}N$ occurs in interstellar clouds, protoplanetary discs, (exo)planetary atmospheres, and other environments due to ultraviolet radiation originating from stellar sources and the presence of cosmic rays. We study this process in detail in search of an explanation for the observed non-elemental ratios of N isotopologues observed in solar system bodies and in molecular clouds.

High-resolution theoretical photodissociation cross sections of N_2 and competing UV-absorbing species are used to calculate the isotope-selective shielding of N_2 in photochemical models of a diffuse interstellar cloud and protoplanetary disk. An enhancement of the atomic $^{15}N/^{14}N$ ratio over the elemental value is obtained due to the self-shielding of external radiation at an extinction of about $A_v = 1$ mag, and leads to a similar mass fractionation in daughter species. This effect is larger where assumed grain growth has reduced the opacity of dust to ultraviolet radiation.

The cosmic-ray induced dissociation of N_2 is calculated from a high-resolution model of H_2 emission and is found to depend sensitively on details of the emission and photodissociation cross sections.