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TI Statistical universal branching ratios for cosmic ray dissociation, photodissociation, and dissociative recombination of the Cn=2-10, Cn=2-4H and C3H2 neutral and cationic species
SO ASTRONOMY & ASTROPHYSICS
LA English
DT Article
DE astrochemistry; molecular data; ISM: clouds; photon-dominated region (PDR)
ID DENSE INTERSTELLAR CLOUDS; CARBON-CHAIN MOLECULES; GAS-PHASE PRODUCTION; COMPLEX HYDROCARBONS; CHEMICAL-MODELS; CROSS SECTIONS; ZETA-OPHIUCHI; CLUSTER IONS; CHEMISTRY; C-3
AB Context. Fragmentation-branching ratios of electronically excited molecular species are of first importance for the modeling of gas phase interstellar chemistry. Despite experimental and theoretical efforts that have been done during the last two decades there is still a strong lack of detailed information on those quantities for many molecules such as C-n, CnH or C3H2. Aims. Our aim is to provide astrochemical databases with more realistic branching ratios for C-n (n = 2 to 10), CnH (n = 2 to 4), and C3H2 molecules that are electronically excited either by dissociative recombination, photodissociation, or cosmic ray processes, when no
detailed calculations or measurements exist in literature. Methods. High velocity collision in an inverse kinematics scheme was used to measure the complete fragmentation pattern of electronically excited C-n (n = 2 to 10), CnH (n = 2 to 4), and C3H2 molecules. Branching ratios of dissociation where deduced from those experiments. The full set of branching ratios was used as a new input in chemical models and branching ratio modification effects observed in astrochemical networks that describe the dense cold Taurus Molecular Cloud-1 and the photon dominated Horse Head region. Results. The comparison between the branching ratios obtained in this work and other types of experiments showed a good agreement. It was interpreted as the signature of a statistical behavior of the fragmentation. The branching ratios we obtained lead to an increase of the C-3 production together with a larger dispersion of the daughter fragments. The introduction of these new values in the photon dominated region model of the Horse Head nebula increases the abundance of C-3 and C3H, but reduces the abundances of the larger C-n and hydrocarbons at a visual extinction AV smaller than 4. Conclusions. We recommend astrochemists to use these new branching ratios. The data published here have been added to the online database KIDA (KInetic Database for Astrochemistry, http://kida.obs.u-bordeaux1.fr).
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