MOLECULAR LIFE-TIME AGAINST PHOTODISSOCIATION IN DARK INTERSTELLAR CLOUDS

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1. INTRODUCTION

Molecules in the interstellar space are exposed to interstellar radiation, so that they are destroyed by photodissociation processes, leading to the production of smaller molecules and ions, which in turn can react with other molecular species. Therefore, dissociation rates and dissociation products are important for the chemistry of interstellar molecules. This holds true also for relatively opaque and dense clouds ($\tau \lesssim 10$ in the visual), due to the multiple scattering of UV radiation by dust.

We present here some preliminary results of our computations of the lifetime of molecules within interstellar clouds, made under different assumptions for the extinction and scattering properties of the dust and for different assumptions about density distribution inside the clouds,

2. BASIC ASSUMPTIONS AND RESULTS

We consider a static cloud. Inside the cloud, there are no radiation sources; the molecules are exposed only to interstellar radiation. Only interaction of radiation with dust grains is taken into account.

The radiation field adopted is the one by Mezger et al (1982).

To compute the radiation field inside the clouds, we solved the transfer equation in spherical symmetry (Aiello et al., 1984).

All calculations have been carried out for clouds with total (edge to edge) visual optical depth = 10.

In order to investigate the effect of different assumptions about dust particles and cloud structure, we carried out computations for three different cases:

1. The density inside the cloud is assumed to be constant. The mean interstellar extinction curve (Savage and Mathis, 1979) is adopted. The scattering parameters are those computed by Draine and Lee (1984) for a graphite-silicate mixture.

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II. The density is as above. The extinction curve towards σ Sco is adopted (Snow and York, 1975). The scattering parameters are those measured by Mathis et al. (1981) in Orion, a region which also exhibits flat UV extinction.

III. The gas and dust densities are assumed to be constant in a central core (r ~ 0.1) and following an inverse square law in the outer region of the cloud. The gas density ($n(H_2)$) is assumed to be 10^4 cm^{-3}. The visual optical depth along the radius is derived assuming that the relation between A_V and the total hydrogen column density N ($H + 2H_2$) obtained for the general interstellar medium holds true within dark clouds. The extinction curve and scattering parameters are the same as for case I.

In all cases the adopted photodissociation cross-sections are derived from Lee (1984). The resulting life-times at the centre (C) and at the edge (E) of the cloud are given in the table below.

MOLECULAR PHOTODISSOCIATION LIFE-TIMES
(t in years. Number in brackets indicates the power of 10)

	I		II		III	
	C	E	C	E	C	E
CO	6.4(8)	2.8(3)	1.5(6)	2.6(3)	2.7(8)	2.4(3)
NO	1.2(6)	2.6(2)	3.5(4)	2.6(2)	7.4(5)	2.3(2)
H_2O	1.2(6)	1.5(2)	2.6(4)	1.4(2)	7.1(5)	1.3(2)
HCN	3.4(6)	7.0(1)	2.3(4)	6.8(1)	1.8(6)	6.0(1)
NO_2	4.2(5)	6.8(1)	1.0(4)	6.6(1)	2.5(5)	5.9(1)
SO_2	5.9(5)	4.6(1)	8.0(3)	4.4(1)	3.3(5)	4.0(1)
CS_2	6.3(4)	1.4(1)	1.7(3)	1.3(1)	3.7(4)	1.2(1)
OCS	1.4(5)	2.4(1)	3.4(3)	2.3(1)	8.7(4)	2.1(1)
NH_3	7.2(5)	8.6(1)	1.4(4)	8.4(1)	4.1(5)	7.5(1)
CH_4	3.1(6)	9.1(1)	2.2(4)	8.8(1)	1.6(6)	7.9(1)
H_2O_2	1.2(6)	1.1(2)	1.9(4)	1.0(2)	7.0(5)	9.2(1)
C_2H_2	4.0(5)	2.9(1)	5.0(3)	2.7(1)	2.3(5)	2.5(1)

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