

Appendix N

Permanent electric dipole moments

N: PERMANENT ELECTRIC DIPOLE MOMENTS

Table N.1: Permanent electric dipole moments (in Debye) of molecules ordered by mass (Rate99: The UMIST database for astrochemistry, Le Teuff et al. 2000). References are given for those cases in which the values have been updated since Rate99.

Species	μ_D	Species	μ_D	Species	μ_D	Species	μ_D	Species	μ_D
H ₂	0	CH	1.46	CH ₂	0.57	NH	1.3	CH ₃	0
NH ₂	1.83	CH ₄	0	NH ₃	1.47	OH	1.66	H ₂ O	1.85
HF	1.83	C ₂	0	C ₂ H	0.8	C ₂ H ₂	0	CN	1.45
HNC	3.05	HCN	2.98	C ₂ H ₃	1.5	H ₂ CN	2.54	N ₂	0
C ₂ H ₄	0	CO	0.11	C ₂ H ₅	0	HCO	1.0	SiH	0.12
CH ₂ NH	2.02	SiH ₂	0.18	NO	0.15	C ₂ H ₆	0	H ₂ CO	2.33
HOCH	0	SiH ₃	0	HNO	1.67	SiH ₄	0	PH	0.64
CH ₃ OH	1.7	O ₂	0	O ₂ H	2.09	PH ₂	0.0	HS	0.76
H ₂ O ₂	1.57	H ₂ S	0.97	C ₃	0	HCl	1.08	l-C ₃ H	3.1
c-C ₃ H ₂	3.4	H ₂ CCC	4.1	C ₂ N	0.6	C ₃ H ₃	4.0	CH ₂ CN	1.62
C ₂ O	1.3	CH ₃ CCH	0.78	SiC	1.7	CH ₃ CN	3.92	HCSi	0.07
NH ₂ CN	0	CH ₂ CO	1.42	SiCH ₂	...	OCN	0.64	SiN	2.3
SiCH ₃	0.65	HNSi	0.16	CP	0.86	N ₂ O	0.16	CS	1.96
HCP	0.3	CH ₃ CHO	2.69	CO ₂	0	SiO	3.1	HCS	1.02
PN	2.75	CH ₃ OCH ₃	1.3	C ₂ H ₅ OH	1.44	CH ₂ PH	0	H ₂ SiO	3.82
H ₂ CS	1.65	NO ₂	0.32	NS	1.81	HCOOH	1.41	CCl	1.22
PO	1.88	C ₄	0	HPO	2.33	SO	1.55	C ₄ H	0.9
C ₄ H ₂	0	C ₃ N	2.2	C ₄ H ₃	0	ClO	1.24	HC ₃ N	3.6
NCCN	0	SiC ₂	2.39	C ₃ O	2.39	CH ₂ CHCN	3.89	SiC ₂ H	1.4
SiNC	2.03	SiC ₂ H ₂	2.5	CCP	3.5	C ₂ S	2.8	HC ₂ P	...
C ₂ H ₆ CO	2.8	C ₅	0	HCOOCH ₃	1.77	OCS	0.71	SiS	1.73
SiO ₂	0.5	C ₅ H	4.3	C ₄ N	0.14	C ₅ H ₂	5.9	SO ₂	1.63
S ₂	0	CH ₃ C ₄ H	1.21	SiC ₃	4.2	SiC ₃ H	2.0 ?	CH ₃ C ₃ N	4.91
HS ₂	1.4	H ₂ S ₂	1.2	C ₃ P	2.77	C ₃ S	3.7	C ₆	0
C ₆ H	5.0	C ₆ H ₂	6.2	C ₅ N	3.38	HC ₅ N	4.33	SiC ₄	6.3
C ₆ H ₆	0	C ₄ P	4.18	C ₄ S	3.8	C ₇	0	C ₇ H	4.5
C ₇ H ₂	7.7	CH ₃ C ₆ H	1.5	CH ₃ C ₅ N	5.75	C ₈	0	C ₈ H	5.0
C ₇ N	3.0	C ₈ H ₂	8.2	HC ₇ N	4.62	C ₉	0	C ₉ H	4.7
C ₉ H ₂	9.7	CH ₃ C ₇ N	5.47	C ₁₀	0	C ₉ N	3.3	HC ₉ N	4.84
HCO ⁺	3.9	N ₂ H ⁺	3.4						

Notes: c-C₃H = 2.4D; HCCCCH = 0D; H₂C₃H(propargyl) = 0.14D; H₂CCCC = 4.1D from Oswald & Botschwina (1995); HCSi from Smith et al. (2001); HCS from Ochsenfeld et al. (1999); HS₂ from Zhuo et al. (1994); CCP from El-Yazal et al. (1997); CCl from Largo et al. (2001); H₂SiO from Ma & Schaeffer (1994); SiCH₃ from Kaiser & Osamura (2005); C₃P from del Rio et al. (1996); C₄P from Yu et al. (2005); C₄S from Pascoli & Lavendry (1998); C₅N from Botschwina (1996); C_nH₂, n = 5–9, from Maluendes & McLean (1992); HNC from Nature (1976).

Table N.2: Permanent electric dipole moments (in Debye) of molecules ordered by name (Rate99: The UMIST database for astrochemistry, Le Teuff et al. 2000). References are given for those cases in which the values have been updated since Rate99.

Species	μ_D	Species	μ_D	Species	μ_D	Species	μ_D	Species	μ_D
C ₂	0	C ₅ N	3.38	CH ₃ C ₆ H	1.5	HCN	2.98	OCS	0.71
C ₂ H	0.8	C ₆	0	CH ₃ C ₇ N	5.47	HCO	1.0	OH	1.66
C ₂ H ₂	0	C ₆ H	5.0	CH ₃ CCH	0.78	HCO ⁺	3.9	PH	0.64
C ₂ H ₃	1.5	C ₆ H ₂	6.2	CH ₃ CHO	2.69	HCOOCH ₃	1.77	PH ₂	0.0
C ₂ H ₄	0	C ₆ H ₆	0	CH ₃ CN	3.92	HCOOH	1.41	PN	2.75
C ₂ H ₅	0	C ₇	0	CH ₃ OCH ₃	1.3	HCP	0.3	PO	1.88
C ₂ H ₅ OH	1.44	C ₇ H	4.5	CH ₃ OH	1.7	HCS	1.02	S ₂	0
C ₂ H ₆	0	C ₇ H ₂	7.7	CH ₄	0	HCSi	0.07	SiC	1.7
C ₂ H ₆ CO	2.8	C ₇ N	3.0	ClO	1.24	HF	1.83	SiC ₂	2.39
C ₂ N	0.6	C ₈	0	CN	1.45	HNC	3.05	SiC ₂ H	1.4
C ₂ O	1.3	C ₈ H	5.0	CO	0.11	HNO	1.67	SiC ₂ H ₂	2.5
C ₂ S	2.8	C ₈ H ₂	8.2	CO ₂	0	HNSi	0.16	SiC ₃	4.2
C ₃	0	C ₉	0	CP	0.86	HOCH	0	SiC ₃ H	2.0 ?
l-C ₃ H	3.1	C ₉ H	4.7	CS	1.96	HPO	2.33	SiC ₄	6.3
c-C ₃ H ₂	3.4	C ₉ H ₂	9.7	H ₂	0	HS	0.76	SiCH ₂	...
C ₃ H ₃	4.0	C ₉ N	3.3	H ₂ CCC	4.1	HS ₂	1.4	SiCH ₃	0.65
C ₃ N	2.2	C ₁₀	0	H ₂ CN	2.54	N ₂	0	SiH	0.12
C ₃ O	2.39	CCl	1.22	H ₂ CO	2.33	N ₂ H ⁺	3.4	SiH ₂	0.18
C ₃ P	2.77	CCP	3.5	H ₂ CS	1.65	N ₂ O	0.16	SiH ₃	0
C ₃ S	3.7	CH	1.46	H ₂ O	1.85	NCCN	0	SiH ₄	0
C ₄	0	CH ₂	0.57	H ₂ O ₂	1.57	NH	1.3	SiN	2.3
C ₄ H	0.9	CH ₂ CHCN	3.89	H ₂ S	0.97	NH ₂	1.83	SiNC	2.03
C ₄ H ₂	0	CH ₂ CN	1.62	H ₂ S ₂	1.2	NH ₂ CN	0	SiO	3.1
C ₄ H ₃	0	CH ₂ CO	1.42	H ₂ SiO	3.82	NH ₃	1.47	SiO ₂	0.5
C ₄ N	0.14	CH ₂ NH	2.02	HC ₂ P	...	NO	0.15	SiS	1.73
C ₄ P	4.18	CH ₂ PH	0	HC ₃ N	3.6	NO ₂	0.32	SO	1.55
C ₄ S	3.8	CH ₃	0	HC ₅ N	4.33	NS	1.81	SO ₂	1.63
C ₅	0	CH ₃ C ₃ N	4.91	HC ₇ N	4.62	O ₂	0		
C ₅ H	4.3	CH ₃ C ₄ H	1.21	HC ₉ N	4.84	O ₂ H	2.09		
C ₅ H ₂	5.9	CH ₃ C ₅ N	5.75	HCl	1.08	OCN	0.64		

Notes: c-C₃H = 2.4D; HCCCCH = 0D; H₂C₃H(propargyl) = 0.14D; H₂CCCC = 4.1D from Oswald & Botschwina (1995); HCSi from Smith et al. (2001); HCS from Ochsenfeld et al. (1999); HS₂ from Zhuo et al. (1994); CCP from El-Yazal et al. (1997); CCl from Largo et al. (2001); H₂SiO from Ma & Schaeffer (1994); SiCH₃ from Kaiser & Osamura (2005); C₃P from del Rio et al. (1996); C₄P from Yu et al. (2005); C₄S from Pascoli & Lavendry (1998); C₅N from Botschwina (1996); C_nH₂, n = 5–9, from Maluendes & McLean (1992); HNC from Nature (1976).

N: PERMANENT ELECTRIC DIPOLE MOMENTS