THz Line List

Compiled by C. A. Gottlieb (January 2002)

1. INTRODUCTION

This memo contains a preliminary list of line frequencies of atomic and molecular species for spectral line astronomy in the region from appoximately 0.8 to 2.0 THz. Table 1 summarizes the species that have been included in the compilation, the spectroscopic designation of the ground state, the permanent electric dipole moment (μ), and references to papers describing prior astronomical observations in the THz or far IR regions. Line frequencies for H_2O, H_2S, and their isotopic species have been omitted, because they can obtained from the HITRAN data base which is maintained by members of the AMP division.

Table 2 is a list of line frequencies for the species referred to in Table 1. This list is intended to serve as a guide to members of the THz receiver group and to spectral line astronomers in the R&G division. The line frequencies (in GHz) have been truncated and are quoted only to the nearest 0.1 GHz, however Gottlieb will provide the best available frequency if it is decided that a particular line may be observed with the THz telescope. If a species is enclosed in [brackets], the line frequency is approximate owing to either: (i) neglect of fine or hyperfine structure, (ii) imprecise spectroscopic constants in the lieterature, or (iii) not having used the full Hamiltonian to calculate the frequency. The atmospheric transmission is from zenith measurements on 25 November 2000 at Sairecabur, Chile for ~ 250 microns of precipitable water vapor (S. Paine, personal communication). If the measured transmission was < 0.01, it is indicated as zero in Table 2.

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Table 1. Atomic and Molecular Species

Species	Spec. State	μ (D)	Table Ref.	Astronomical Tel.	Astronomical Ref.
Atoms:					
C	X^3P				
C^+	X^2P				p1994
O	X^3P				
N^+	X^3P			*KAO*	p1994
				COBE	cobe1991,1999
				ISO	g2000
Diatomic molecules:					
CH	$X^2\Pi$	1.46		*ISO*	liu1997
CH^+	$X^1\Sigma^+$			*ISO*	c1997
NH	$X^3\Sigma^-$	1.389		*ISO*	cgc2000
NH^+	$X^2\Pi$				
OH	$X^2\Pi$	1.655		*ISO*	
OH^+	$X^3\Sigma^-$	2.32			
SH	$X^2\Pi$	0.758			
$\mathbf{SH}^+$	$X^3\Sigma^-$	1.285			
SiH	$X^2\Pi$	0.124			
$\mathbf{SiH}^+$	$X^1\Sigma^+$				
MgH	$X^2\Sigma^+$	1.275			
MgH^+	$X^1\Sigma^+$				
LiH	$X^1\Sigma^+$	5.882			
NaH	$X^1\Sigma^+$	6.7			
KH	$X^1\Sigma^+$	8.136			
FeH	$X^4\Delta_{7/2}$	2.9 ?			
HCl	$X^1\Sigma^+$	1.109		*KAO*	zbckm1995
				CSO	spw1995
HF	$X^1\Sigma^+$	1.826		*ISO*	nzsp1997
CO	$X^1\Sigma^+$	0.112			
CO^+	$X^2\Sigma^+$	2.771		*ISO*	ccrnsw1998,g2000

Table 1—Continued

Species	Spec. State	μ (D)	Table Ref.	Astronomical Tel.	Astronomical Ref.
Diatomic molecules (continued):					
CF	$X^2\Pi$	0.65			
CN	$X^2\Sigma$	1.45			
PH	$X^3\Sigma$	0.396			
Triatomic molecules:					
CH_2	X^3B_1	0.57			
$\mathbf{H_2^{18}O}$		1.847			
$\mathbf{H_2S}$		0.974			
HCN	$X^1\Sigma$	2.9852			
CCH	$X^2\Sigma$	0.769			
HCO					
H_2D^+		0.6		*JCMT*	std1999
				KAO?	bb1993
HDO					
HNO					
CCC	$X^1\Sigma$	0.437		*KAO*?	g2001
				ISO	cgc2000
Tetratomic molecules:					
NH_3				*ISO*	
$\mathbf{H_3O^+}$		1.44		*KAO*	bb1993
$\mathbf{H_3S^+}$		1.731			
HNCO		1.350			
$\mathbf{HOCO^+}$					
HCCO					

NOTE — Species in **boldface** are not yet included in the list of THz line frequencies.