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# Absolute frequency measurement of $^{12}\text{C}^{16}\text{O}_2$ laser lines with a femtosecond laser comb and new determination of the $^{12}\text{C}^{16}\text{O}_2$ molecular constants and frequency grid

Anne Amy-Klein, H el ene Vigu e, Christian Chardonnet

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Anne Amy-Klein, H el ene Vigu e, Christian Chardonnet. Absolute frequency measurement of  $^{12}\text{C}^{16}\text{O}_2$  laser lines with a femtosecond laser comb and new determination of the  $^{12}\text{C}^{16}\text{O}_2$  molecular constants and frequency grid. *Journal of Molecular Spectroscopy*, 2004, 228, pp.206-212. hal-00003427

**HAL Id: hal-00003427**

**<https://hal.science/hal-00003427>**

Submitted on 30 Nov 2004

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Table 1

<b>CO<sub>2</sub> laser line</b>	<b>Absolute frequency</b>	<b>Present data – Maki' s grid frequencies [5]</b>
9P(46)	30 610 516 136,13 (36)	-6,7
9P(44)	30 674 445 765,70 (11)	-6,7
9P(42)	30 737 656 701,45 (50)	-6,6
9P(38)	30 861 897 509,38 (38)	-5,6
9P(36)	30 922 915 425,64 (12)	-5,3
9P(34)	30 983 190 748,786 (60)	-4,5
9P(24)	31 273 247 146,942 (52)	-1,5
9P(22)	31 328 961 496,109 (51)	-1,4
9P(20)	31 383 900 400,957 (53)	-1,5
9P(8)	31 697 061 417,21 (31)	-5,3
9P(6)	31 746 483 780,87 (20)	-5,9
9P(4)	31 795 108 666,12 (10)	-6,4
9R(4)	32 004 017 376,37 (14)	-6,0
9R(6)	32 048 236 244,416 (72)	-5,5
9R(10)	32 134 266 887,519 (52)	-4,2
9R(12)	32 176 079 484,167 (52)	-3,6
9R(20)	32 335 334 038,602 (63)	-1,8
9R(22)	32 373 156 202,180 (64)	-1,8
9R(34)	32 583 536 629,26 (11)	-4,3
9R(36)	32 615 869 688,51 (23)	-4,9

Table 2 :

<b>CO<sub>2</sub> laser line</b>	<b>CO<sub>2</sub> frequency deduced from [12] and [8]</b>
10P(24)	28 196 922 608,45 (71)
10P(22)	28 251 941 665,05 (21)
10P(20)	28 306 224 891,73 (21)
10P(18)	28 359 773 811,63 (13)
10P(16)	28 412 589 726,42 (10)
10P(14)	28 464 673 719,39 (15)
10P(12)	28 516 026 657,62 (10)
10P(10)	28 566 649 193,011 (78)
10P(8)	28 616 541 764,825 (78)
10R(6)	28 967 457 064,145 (85)
10R(10)	29 054 072 700,91 (12)
10R(12)	29 096 274 394,13 (14)
10R(14)	29 137 736 114,21 (12)
10R(16)	29 178 455 677,778 (72)
10R(18)	29 218 430 687,37 (12)
10R(20)	29 257 658 529,53 (17)
10R(22)	29 296 136 371,04 (16)
10R(24)	29 333 861 160,42 (12)
10R(26)	29 370 829 620,81 (12)

Table 3a

	Present fit	Maki [5]
$B_0$	11 606 206,949 1 (17)	11 606 206,933 (12)
$D_0 \times 10^3$	3 988,065 9 (49)	3 988,024 (16)
$H_0 \times 10^9$	457,7 (59)	423,4 (76)
$L_0 \times 10^{12}$	-6,9 (22)	2,1 (11)
$v_I$	28 808 813 819,16 (12)	28 808 813 821,6 (4)
$B_I$	11 697 569,424 1 (25)	11 697 569,430 (13)
$D_I \times 10^3$	3 445, 914 (13)	3 445,896 (18)
$H_I \times 10^9$	5 642 (26)	5 594,2 (87)
$L_I \times 10^{12}$	-12 (18)	12,0 (14)
$v_{II}$	31 889 960 164,725 (44)	31 889 960 171,4 (17)
$B_{II}$	11 706 364,607 0 (17)	11 706 364,616 (13)
$D_{II} \times 10^3$	4 711, 454 4 (48)	4 711, 451 (18)
$H_{II} \times 10^9$	7 010,3 (54)	6 997,3 (78)
$L_{II} \times 10^{12}$	-34,5 (19)	-29,8 (11)

Table 3b

$\Delta B_I$	91 362,474 9 (23)
$\Delta D_I \times 10^3$	-542,151 (13)
$\Delta H_I \times 10^9$	5 185 (26)
$\Delta L_I \times 10^{12}$	-6 (18)
$\Delta B_{II}$	100 157,657 90 (44)
$\Delta D_{II} \times 10^3$	723,388 4 (12)
$\Delta H_{II} \times 10^9$	6 552,6 (12)
$\Delta L_{II} \times 10^{12}$	-27,63 (42)

Table 4

CO <sub>2</sub> line	Calc (kHz)	obs-calc	CO <sub>2</sub> line	Calc (kHz)	obs-calc
9P(50)	30 480 527 010,5 (11)		10P(30)	28 027 431 873,3 (14)	
9P(48)	30 545 874 316,37 (52)		10P(28)	28 084 669 800,30 (43)	
9P(46)	30 610 516 135,99 (19)	0,14 [36]	10P(26)	28 141 165 978,56 (11)	
9P(44)	30 674 445 765,724 (70)	-0,02 [11]	10P(24)	28 196 922 609,449 (79)	-1,00 [71]
9P(42)	30 737 656 701,452 (90)	-0,00 [50]	10P(22)	28 251 941 665,158 (61)	-0,11 [21]
9P(40)	30 800 142 644,785 (89)		10P(20)	28 306 224 891,652 (48)	0,08 [21]
9P(38)	30 861 897 509,164 (68)	0,22 [38]	10P(18)	28 359 773 811,488 (43)	0,14 [13]
9P(36)	30 922 915 425,697 (45)	-0,06 [12]	10P(16)	28 412 589 726,375 (35)	0,05 [10]
9P(34)	30 983 190 748,764 (36)	0,022 [60]	10P(14)	28 464 673 719,504 (32)	-0,11 [15]
9P(32)	31 042 718 061,363 (40)		10P(12)	28 516 026 657,643 (34)	-0,02 [10]
9P(30)	31 101 492 180,211 (42)		10P(10)	28 566 649 192,992 (32)	0,019 [78]
9P(28)	31 159 508 160,582 (40)		10P(8)	28 616 541 764,801 (35)	0,025 [78]
9P(26)	31 216 761 300,881 (33)		10P(6)	28 665 704 600,753 (55)	
9P(24)	31 273 247 146,956 (25)	-0,014 [52]	10P(4)	28 714 137 718,110 (84)	
9P(22)	31 328 961 496,125 (21)	-0,016 [51]	10P(2)	28 761 840 924,62 (11)	
9P(20)	31 383 900 400,941 (23)	0,016 [53]	10R(0)	28 832 026 217,11 (12)	
9P(18)	31 438 060 172,666 (28)		10R(2)	28 877 902 435,78 (11)	
9P(16)	31 491 437 384,468 (33)		10R(4)	28 923 046 428,228 (80)	
9P(14)	31 544 028 874,329 (36)		10R(6)	28 967 457 064,183 (52)	-0,037 [85]
9P(12)	31 595 831 747,664 (37)		10R(8)	29 011 133 004,564 (38)	
9P(10)	31 646 843 379,645 (38)		10R(10)	29 054 072 700,845 (41)	0,07 [12]
9P(8)	31 697 061 417,239 (40)	-0,03 [31]	10R(12)	29 096 274 394,165 (42)	-0,03 [14]
9P(6)	31 746 483 780,943 (42)	-0,07 [20]	10R(14)	29 137 736 114,203 (36)	0,01 [12]
9P(4)	31 795 108 666,219 (43)	-0,10 [10]	10R(16)	29 178 455 677,822 (33)	-0,043 [72]
9P(2)	31 842 934 544,639 (44)		10R(18)	29 218 430 687,460 (39)	-0,09 [12]
9R(0)	31 913 172 562,671 (43)		10R(20)	29 257 658 529,304 (45)	0,22 [17]
9R(2)	31 958 996 055,802 (39)		10R(22)	29 296 136 371,203 (54)	-0,16 [16]
9R(4)	32 004 017 376,337 (34)	0,03 [14]	10R(24)	29 333 861 160,367 (64)	0,06 [12]
9R(6)	32 048 236 244,372 (29)	0,044 [72]	10R(26)	29 370 829 620,812 (80)	0,00 [12]
9R(8)	32 091 652 657,003 (24)		10R(28)	29 407 038 250,58 (41)	
9R(10)	32 134 266 887,498 (22)	0,021 [52]	10R(30)	29 442 483 318,7 (13)	
9R(12)	32 176 079 484,185 (23)	-0,018 [52]			
9R(14)	32 217 091 269,029 (25)				
9R(16)	32 257 303 335,915 (28)				
9R(18)	32 296 717 048,638 (28)				
9R(20)	32 335 334 038,592 (28)	0,010 [63]			
9R(22)	32 373 156 202,170 (33)	0,010 [64]			
9R(24)	32 410 185 697,874 (48)				
9R(26)	32 446 424 943,137 (72)				
9R(28)	32 481 876 610,859 (98)				
9R(30)	32 516 543 625,67 (12)				
9R(32)	32 550 429 159,90 (11)				
9R(34)	32 583 536 629,289 (73)	-0,03 [11]			
9R(36)	32 615 869 688,44 (15)	0,07 [23]			
9R(38)	32 647 432 225,96 (44)				
9R(40)	32 678 228 359,40 (96)				