Measured laser frequencies from the optically pumped methanol isotopologue ¹³CD₃OD

Ben Freeman, Dr. Michael Jackson (advisor), Central Washington University, Ellensburg, WA This material is based upon work supported in part by the Washington Space Grant Consortium (Award No. NNX10AK64H).

The far-infrared region of the electromagnetic spectrum, informally defined as the wavelength region between 0.025 mm and 2.00 mm, is an area that has been investigated using laser radiation for over 50 years. Research with far-infrared lasers has a range of applications including terahertz imaging, a form of noninvasive imaging. Creating a catalog of far-infrared laser emissions is also beneficial for their use in high-resolution spectroscopic investigations of stable molecules and short-lived free radicals. The purpose of this research was to measure the frequencies of known far-infrared laser emissions generated by ¹³CD₃OD, an isotopic form of methanol. This was achieved using an optically pumped molecular laser and two carbon dioxide reference lasers. In this work, the frequencies for 16 far-infrared laser emissions have been measured with a one-sigma uncertainty of approximately 0.7 MHz. This poster will cover the experimental procedure used for this research along with the data that was recorded.

Introduction

The underlying principle of a laser was first hypothesized in 1917 by Albert Einstein. LASER is an acronym for: Light Amplification by Stimulated Emissions of Radiation. They can simultaneously emit monochromatic, highly directional, coherent light and have a wide range of applications. In the far-infrared (FIR) region, they have applications in high-resolution spectroscopy and terahertz imaging.

Experimental System

- High voltage power supply excites the molecules in the CO₂ pump laser emitting infrared radiation (around 9 and 10 μ m).
- CO_2 laser radiation subsequently excites the ${}^{13}CD_3OD$ sample present in the far-infrared laser cavity.
- Several operating parameters are adjusted. Any farinfrared lasing that occurs is monitored by the MIM (metal-insulator-metal) point contact diode detector.

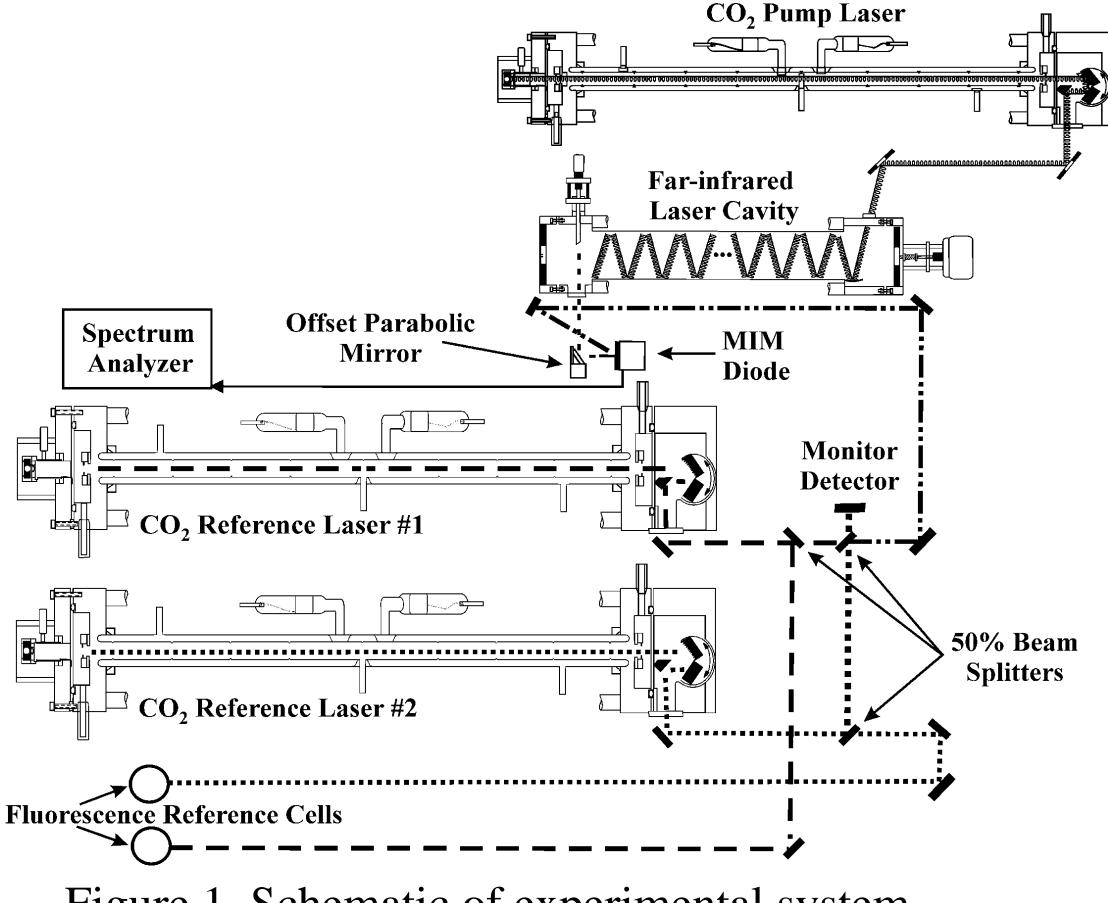


Figure 1. Schematic of experimental system.

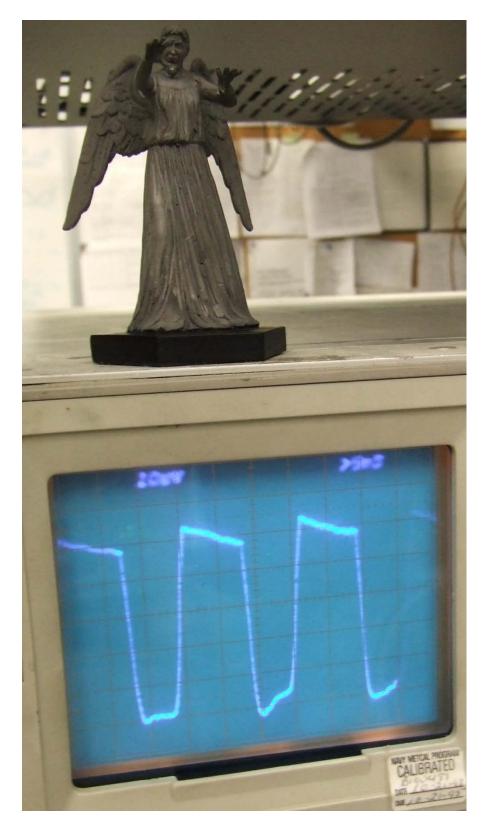
Abstract



Experimental Procedure

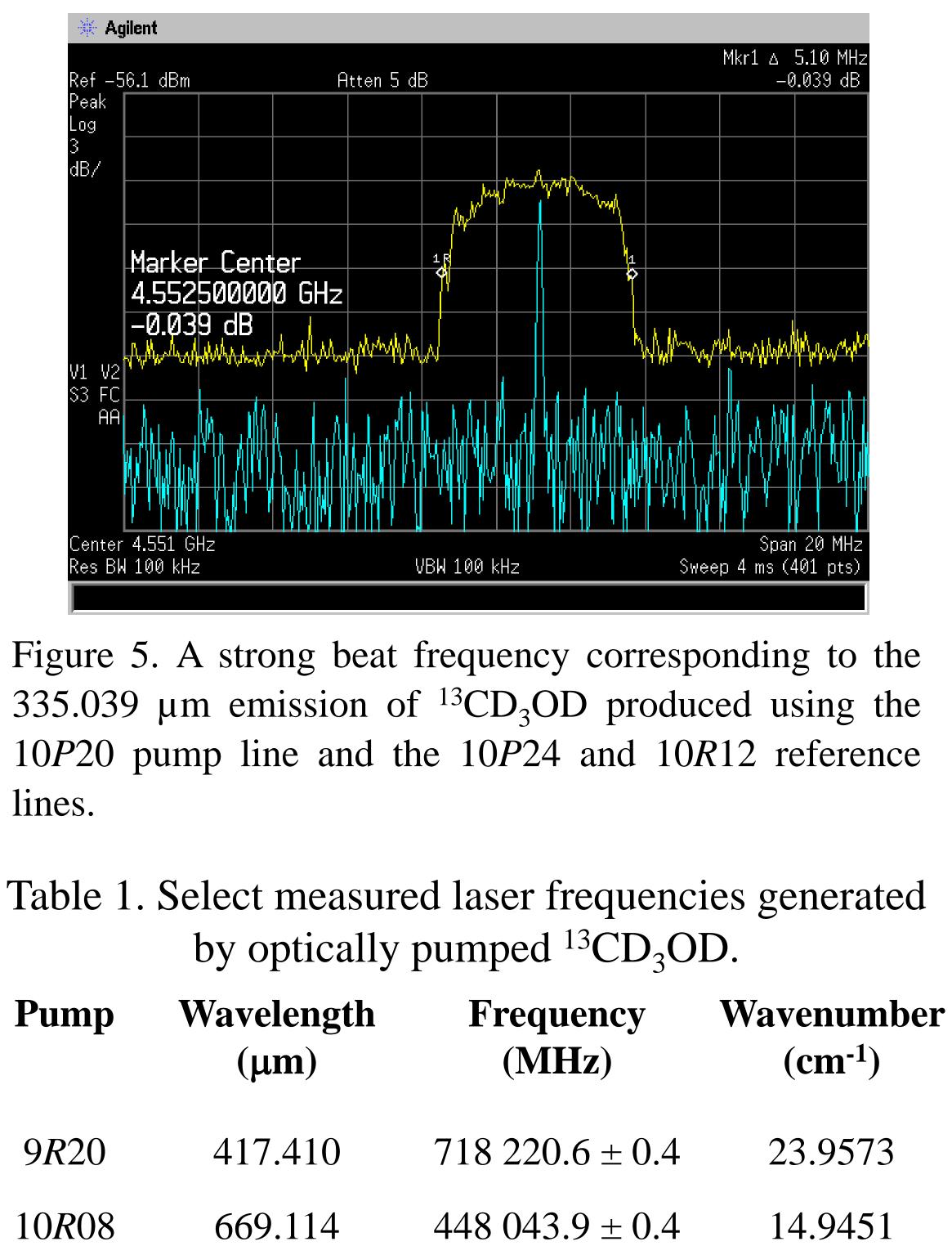
Figure 2. Generating CO₂ laser radiation as observed on a beam stop.

Figure 3. Typical waveform seen on the oscilloscope when FIR laser radiation is detected.



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I626P(50)	27413600.413	I626P(20)	28306224.889	892624.476	1478	1478		
I626P(42)	27668274.452	I626P(10)	28566649.193	898374.741	-4273	-4273		
I626P(30)	28027431.871	I626R(4)	28923046.430	895614.559	-1512	-1512		
I626P(24)	28196922.607	I626R(12)	29096274.394	899351.786	-5250	-5250		
I626P(18)	28359773.809	I626R(20)	29257658.527	897884.718	-3783	-3783		
I626P(12)	28516026.657	I626R(28)	29407038.249	891011.592	3091	3091		
I626P(8)	28616541.766	I626R(34)	29511066.673	894524.907	-423	-423		
I626P(4)	28714137.720	I626R(40)	29608108.136	893970.416	132	132		
I626R(0)	28832026.220	I626R(48)	29726394.758	894368.539	-266	-266		
II626P(48)	30545874.324	II626P(18)	31438060.175	892185.851	1916	1916		
II626P(40)	30800142.651	II626P(8)	31697061.423	896918.771	-2817	-2817		
II626P(28)	31159508.163	II626R(6)	32048236.250	888728.087	5374	5374		
II626P(18)	31438060.175	II626R(20)	32335334.040	897273.866	-3172	-3172		
II626P(2)	31842934.551	II626R(44)	32737539.008	894604.457	-502	-502		
Printscreen does not work, to print these matches rerun the program with screen								
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Eiguna 1 Salasting the appropriate set of CO								
Figure 4. Selecting the appropriate set of CO_2								

reference lasers.



Results

lines.

Pump	Wavelength (µm)	Frequency (MHz)	Waver (cr	
9 <i>R</i> 20	417.410	$718\ 220.6\pm 0.4$	23.9	
10 <i>R</i> 08	669.114	$448\ 043.9 \pm 0.4$	14.9	

Conlusion

During this investigation, sixteen emissions laser generated by the methanol isotopologue ¹³CD₃OD have had their frequencies measured for the first time. The wavelengths for these laser emissions range from 220.406 to 845.168 µm.

