

Background

Current fungi detection methods are extremely slow and can rarely determine the precise species and/or strain of fungi present. In utilizing the Far-IR beamline at the Canadian Light Source, the team hoped that the research conducted may lead to further development of quicker and more accurate methods of fungi detection and identification.

Abstract

The team conducted an experiment that centered on researching the capability of using the Far-IR beamline to distinguish between various species and strains of yeast. Various yeasts were chosen to be fermented and have their resultant headspace gases collected. The absorption spectra of these gases were analyzed for differences. Research conducted prior to the experiment showed that the majority of the gases are comprised of CO₂ and H₂O, causing the spectra to become saturated or extremely unclear. This was one of the obstacles we faced throughout the procedure of the experiment. Analysis of the spectra showed that there is potential evidence that infrared synchrotron light can be used to differentiate between various yeasts.

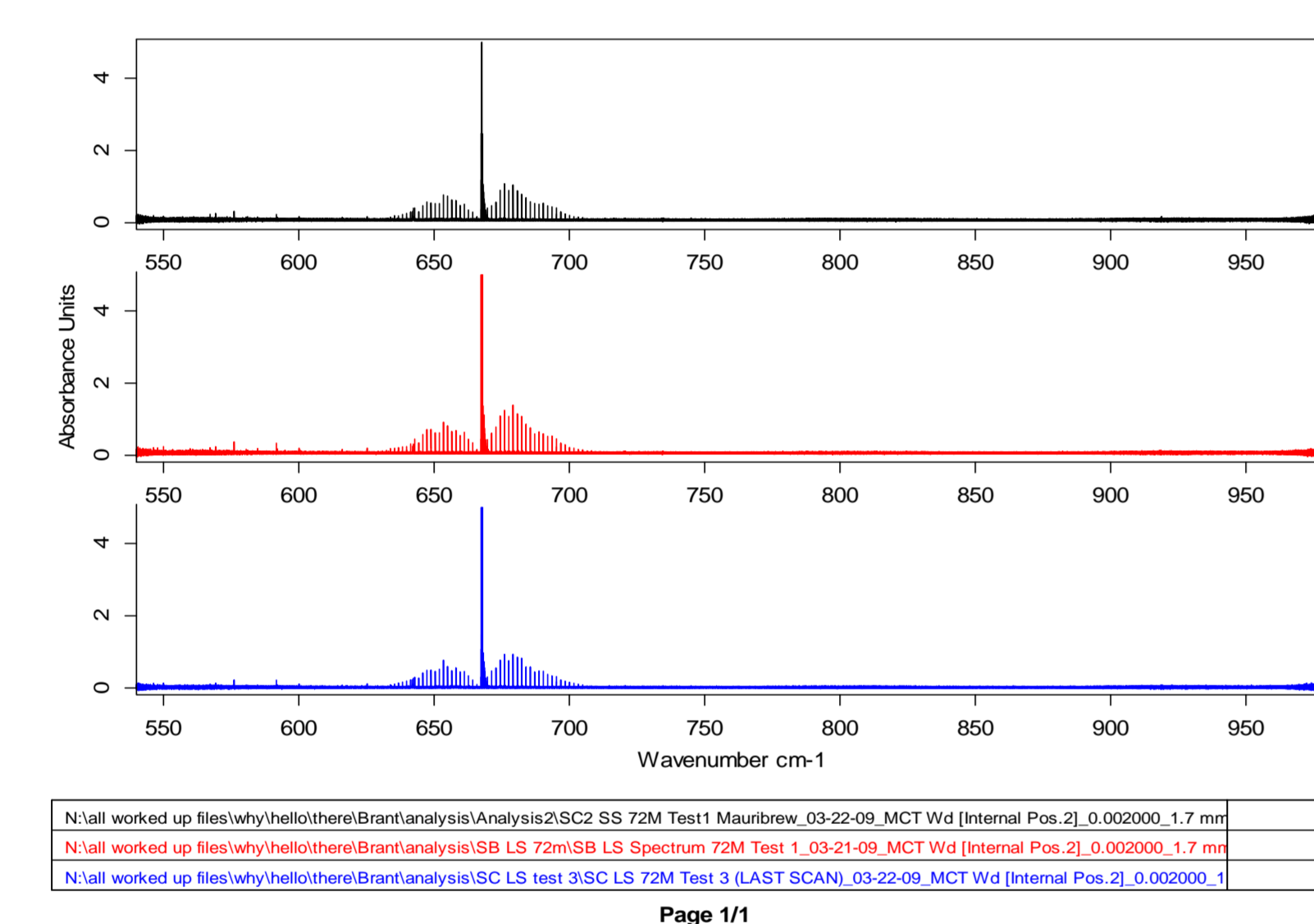
Procedure

A mixture of 5 g of yeast, 5 g sugar, and 150 ml of distilled water was placed into a modified Tupperware container with a seal. The container is connected to a custom stainless steel apparatus that is submerged in a mixture of liquid nitrogen and methanol. The temperature range of the liquid nitrogen and methanol ranged from 203K to 213K. The yeast was allowed to ferment for 30 minutes; thereafter the headspace gas was collected. The amount of CO₂ and H₂O were minimized, as prior research shows that they account for the majority of the sample collected (over 90%) and would saturate the scans.

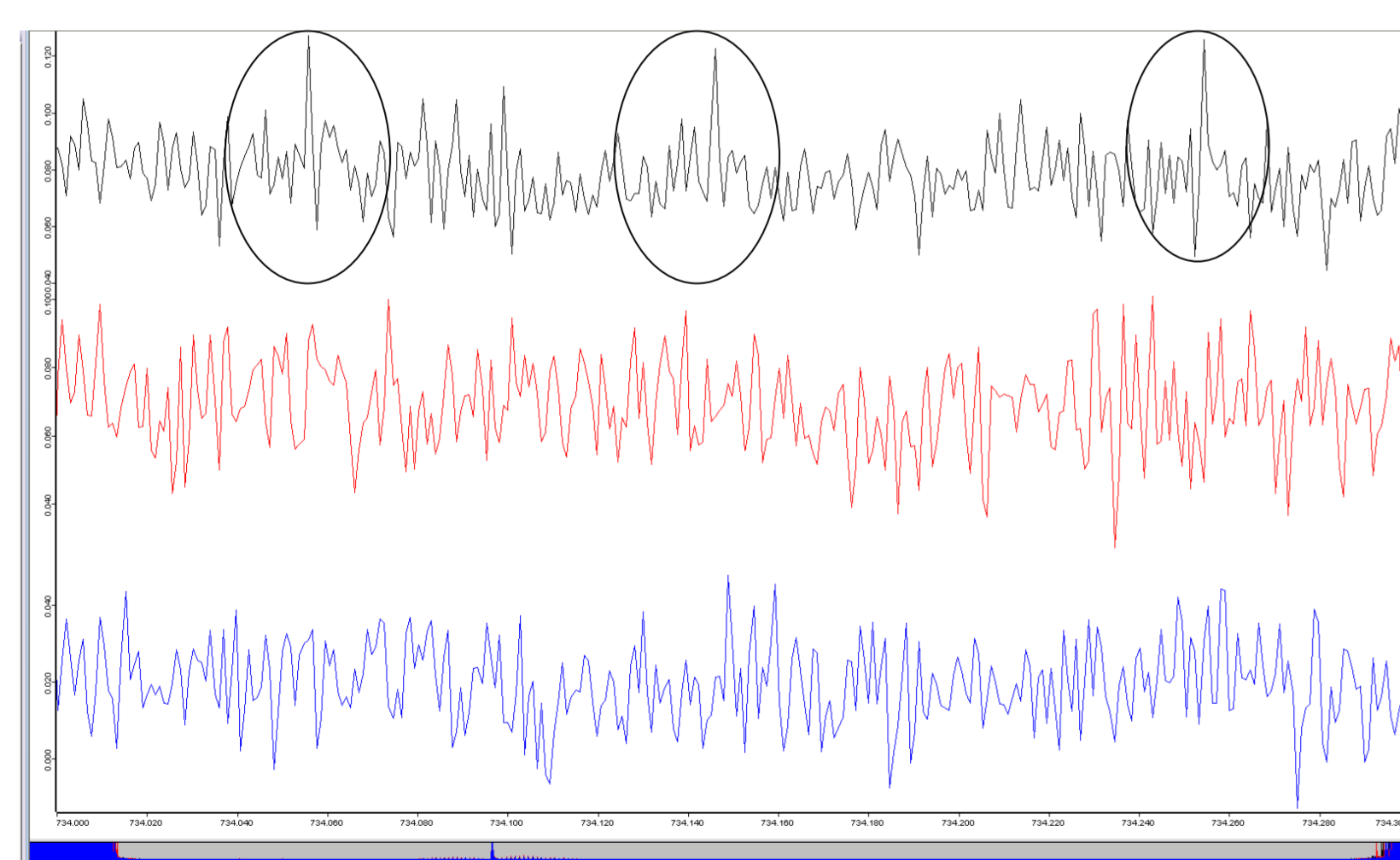
Conclusion

Analysis of the graphs produced from the absorption spectra did not produce a conclusive result due to indistinct possible peaks and time constraint. Despite the attempt to remove carbon dioxide from the headspace sample, a significant amount was still left. The number of scans run was also insufficient to optimally minimize the noise levels in the graphs. Hence, the carbon dioxide peak was the only clearly distinguished peak visible, with potential others barely rising above the noise level. These factors contributed to the inconclusive result of the experiment.

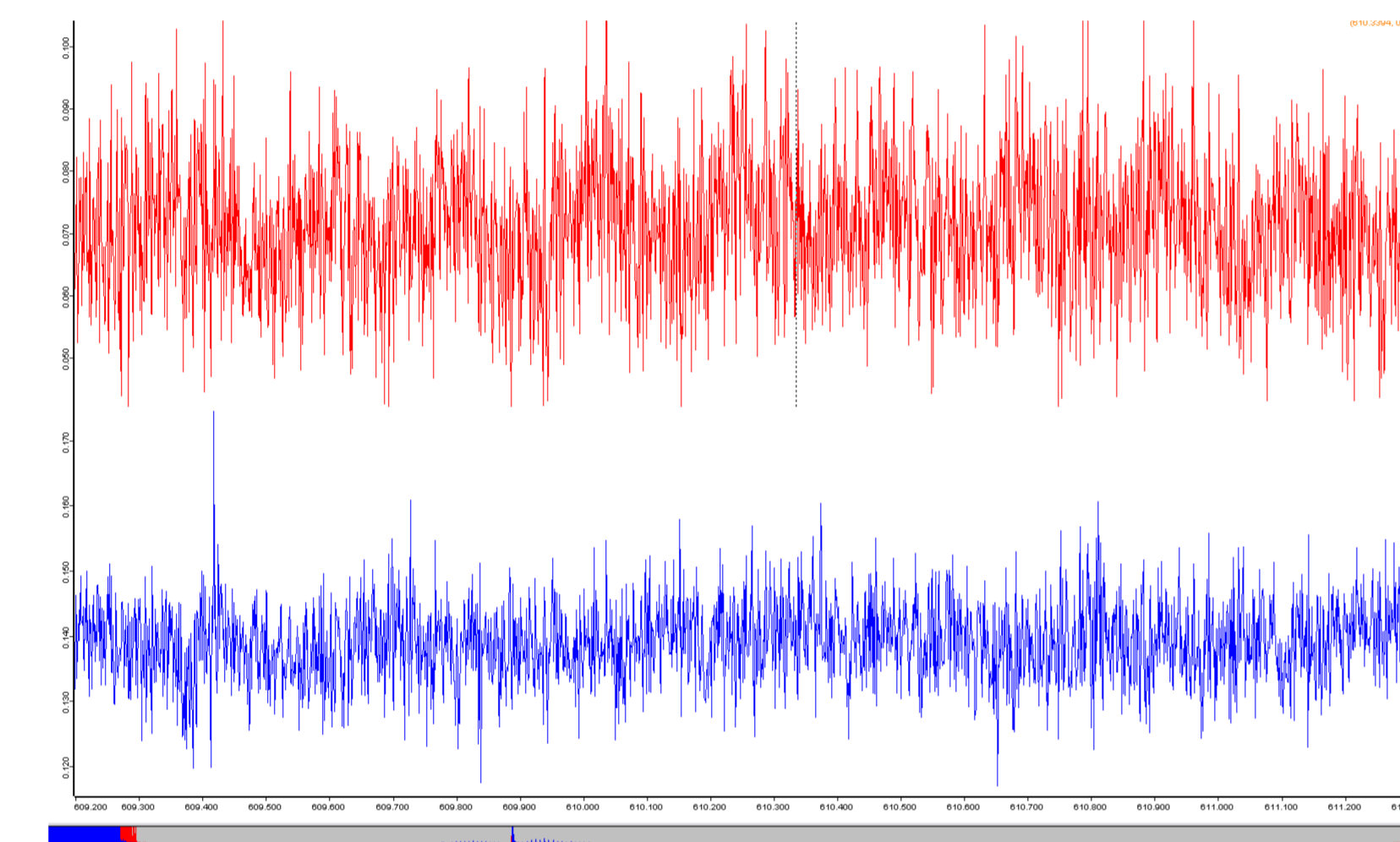
Should an opportunity present itself for a more intensive study, the experiment should be conducted with more scans within a longer period of time and more effective methods to remove the carbon dioxide. For instance, a colder bath could better condense the substances (aside from the carbon dioxide) to remove only the carbon dioxide and retain more headspace sample. It is also advisable to also use a wider variety of yeasts in greater quantities for more pronounced differences in the absorption spectra.



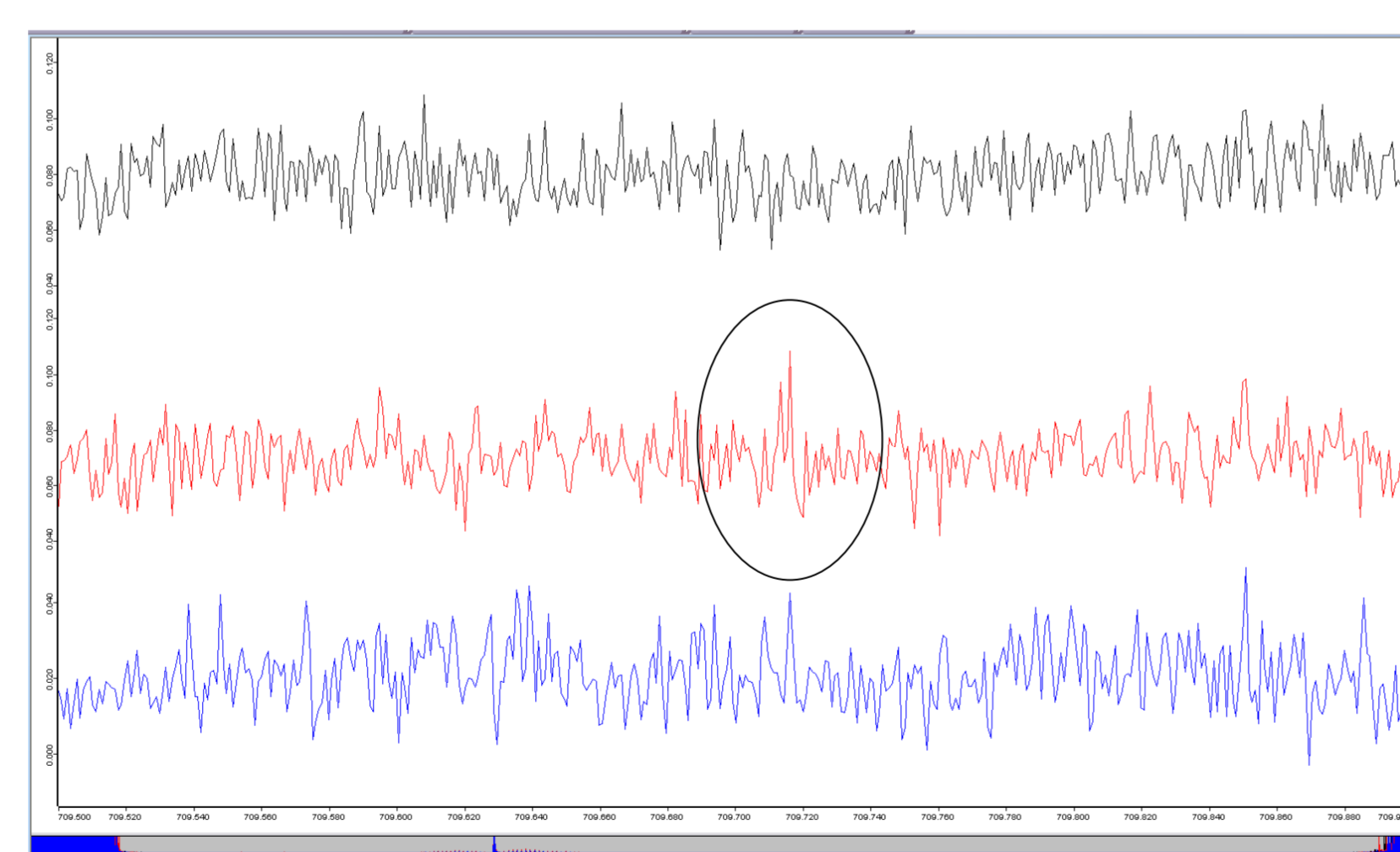
The graphs above are the absorption graphs for Mauribrew (black), Saccharomyces Bayanus (red) and Saccharomyces Cerevisiae (blue) respectively. As expected, the carbon dioxide spectrum is most prominently seen in the total gas spectrum. This suggests that carbon dioxide is the most abundant gas that was produced through the yeast fermentation, despite our effort to eliminate it.



From the above graph, it can be observed that the Mauribrew spectrum has peaks that can not be seen in the S.C. and S.B. spectrum that is neither carbon dioxide nor water. This could potentially be the q-branch of an isotope of a substance that this strain of yeast produces exclusively.



The graphs above are of S.B. (red), which was scanned for 3.5 hours, and S.C. (blue), which was scanned for 12 hours. From this graph, it can be seen that the noise present in the S.C scan is much lower than that of S.B due to the longer scan time. Noise caused the analysis process to be very difficult, as it is hard to determine the actual absorption spectrum.



From the above graph, it can be observed that the S.B spectrum has peaks that can not be seen in the Mauribrew and S.C. spectrum that is neither carbon dioxide nor water. Like the last graph, this could potentially be the q-branch of an isotope of a substance that this strain of yeast produces exclusively.

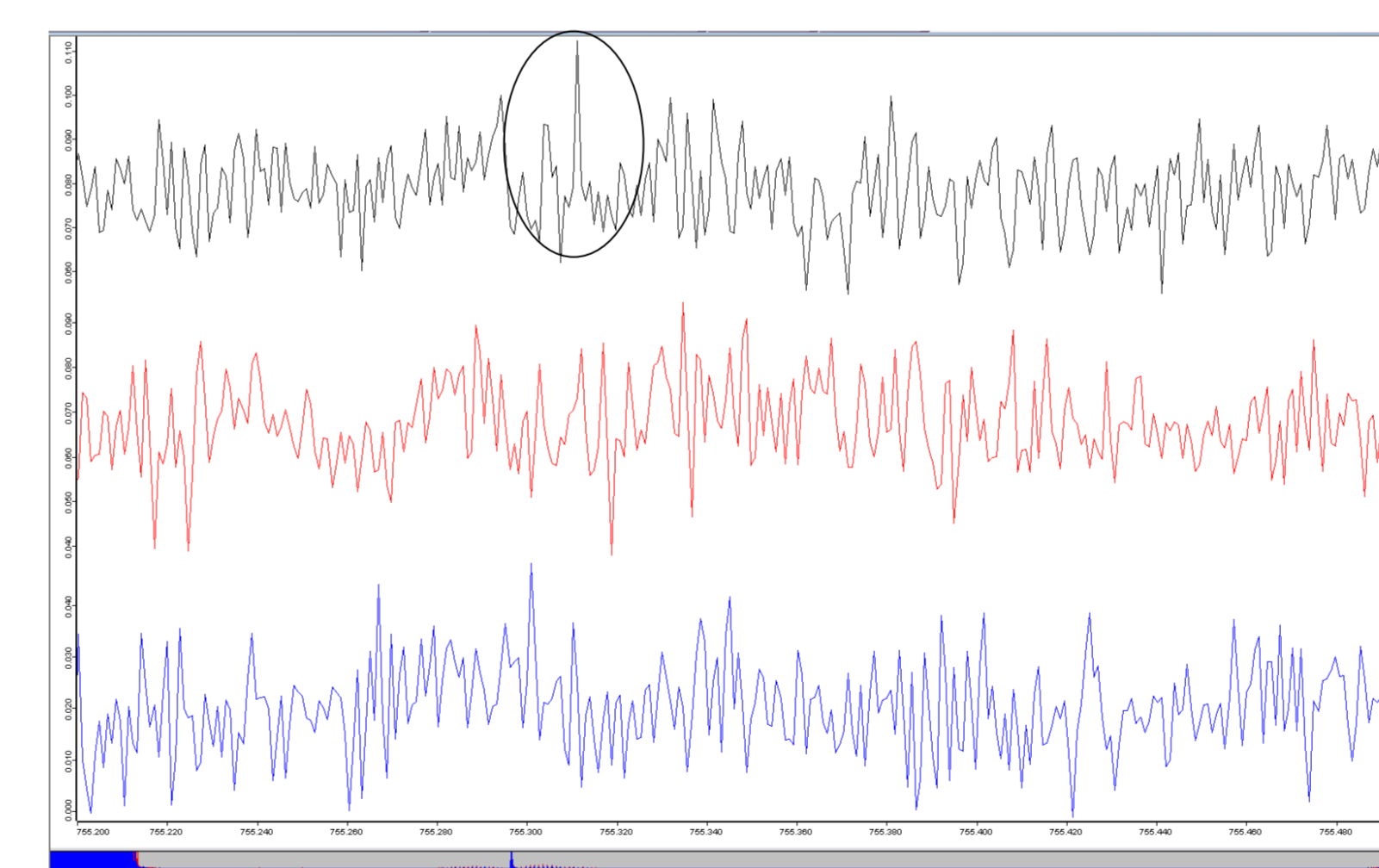
Conditions the scans for the graphs are conducted under:

	Sample Pressure (Torr)	Sample Temperature (K)
Mauribrew	93.2e-3	297.6500
S.B.	9.7e-3	297.8500
S.C	59.9e-3	297.5500

Each scan was conducted with a pathlength of 72 m and resolution of 0.0002cm⁻¹

The S.B. and S.C. scans were long-run (conducted for 12 hours) while the Mauribrew scan was short-run (conducted for 3.5 hours) due to the time constraint.

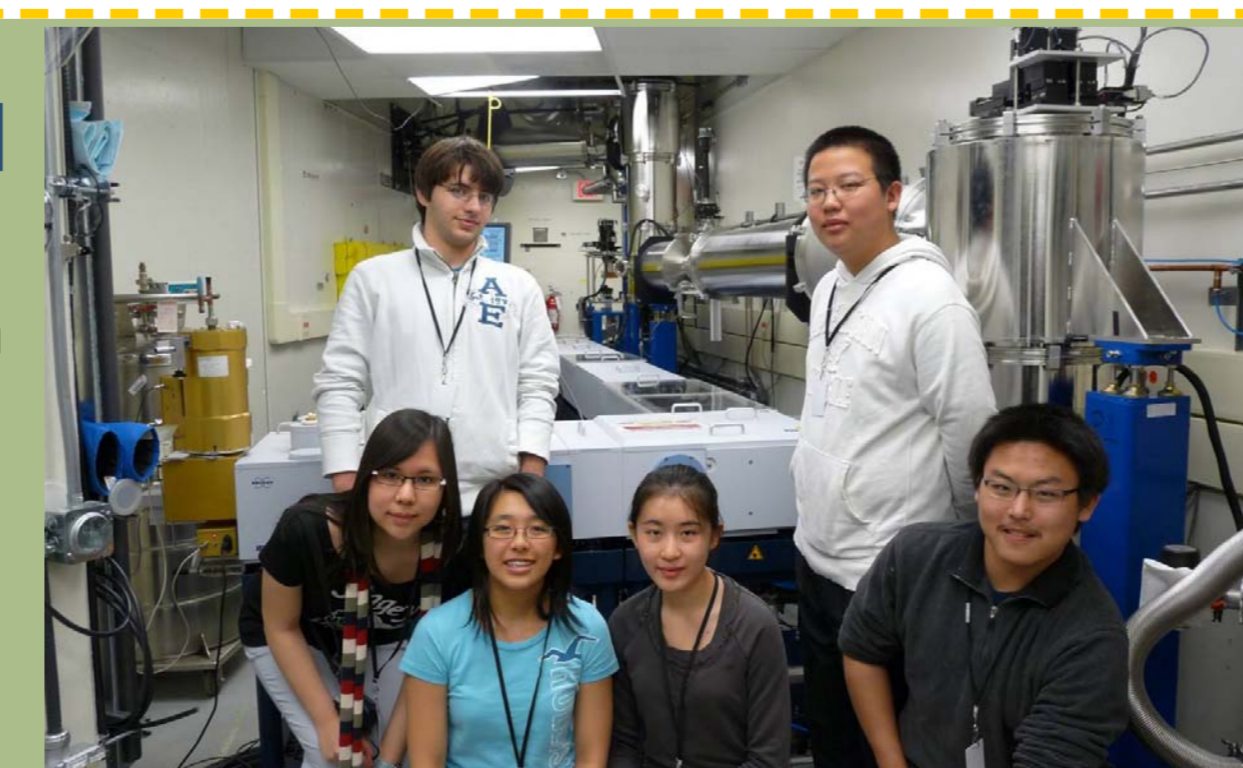
Data



From the above graph, it can be observed that the Mauribrew spectrum has three consecutive peaks that can not be seen in the S.C. and S.B. spectrum that is neither carbon dioxide nor water. This could potentially be the q-branch of an isotope of a substance that this strain of yeast produces exclusively.

ABOUT THE VPCI BEAMLINE TEAM

The VPCI Beamline Team consists of: Kostandin Nino Dhmitri, Jack Gao, Cathy Lian, Charlene Leung, Yerusha Nuh and Daniel Weng. Our teacher-supervisors are Ms. Sarah Torrie and Mr. Felipe Almeida. We are six students from Victoria Park Collegiate Institute in Toronto, Ontario enrolled in the International Baccalaureate Programme. Under the guidance of Dr. Brant Billinghamurst, the CLS Far-IR Beamline Scientist, and the assistance of Tracy Walker; we gained valuable experience and insight in the scientific research field. Being part of an enriched science program, the benefits that the CLS gave us was much needed in our further experiments and studies.



Fermentations Mr. Colin Ross
The Keg Steakhouse & Bar

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