Detecting acoustic noise sensitivity using Michelson interferometer

Aim:

1.Study the difference in fringe patterns due to acoustic noise effects.
2.To determine the sensitivity of the interferometer to acoustic noise.

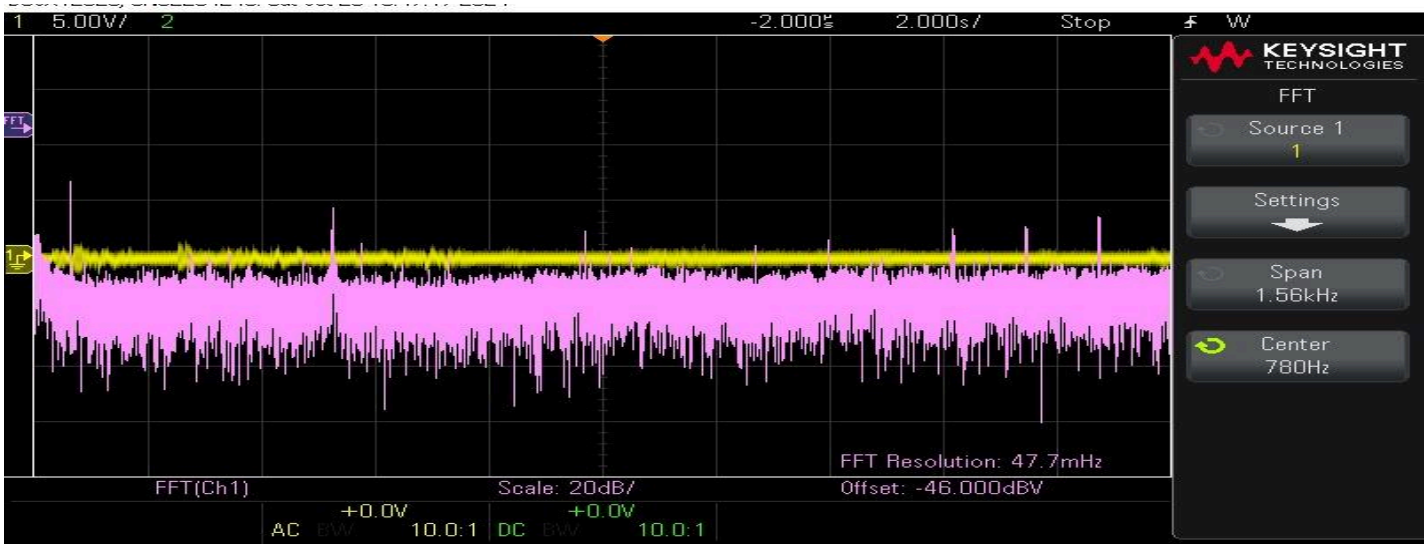
Initial Plan:

Our original plan was to set up a Mach-Zehnder interferometer. We planned to introduce an acoustic noise source in one of the arms of the interferometer and analyse the changes in the fringe pattern using a digital storage oscilloscope (DSO).

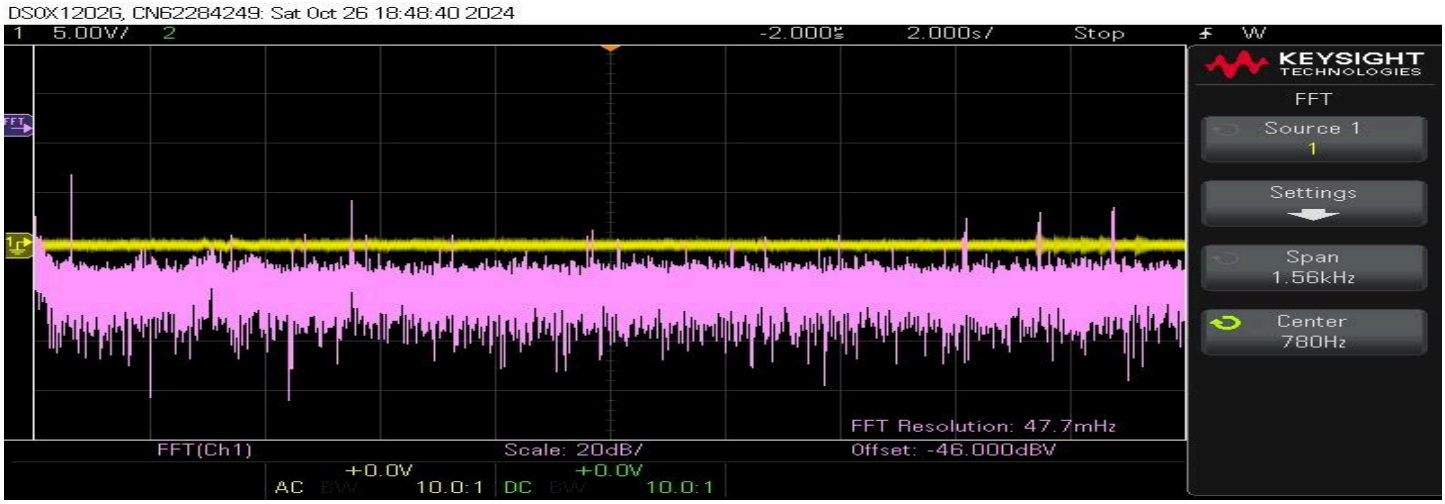
Implementation:

In the actual experiment, we ended up working with a Michelson interferometer. As per the initial plan, we placed a speaker in one of the arms to serve as an acoustic noise source. We played sounds of different volumes and frequencies. Then, we obtained data using the photodiode connected to a DSO in the form of graphs.

Observations (Fast Fourier Transforms) :

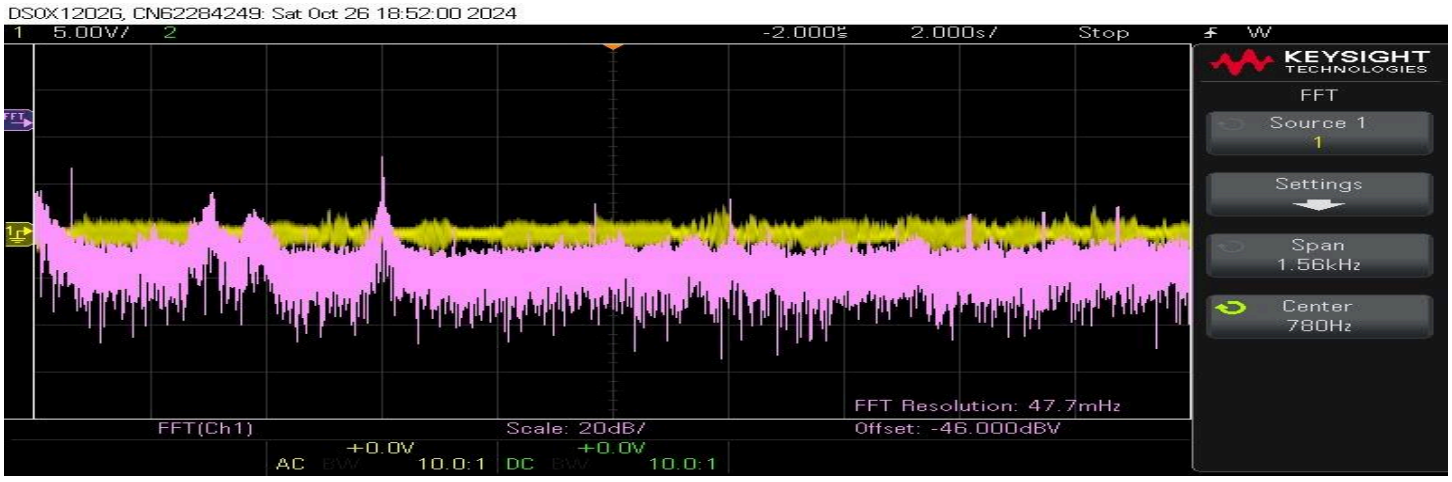


410 Hz

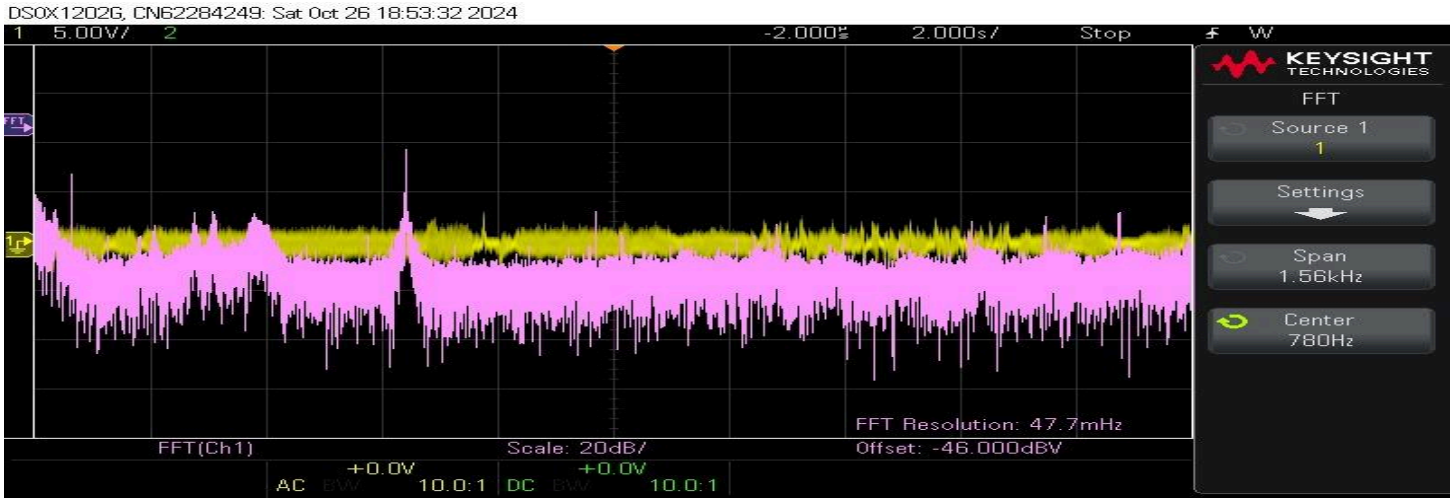


430Hz

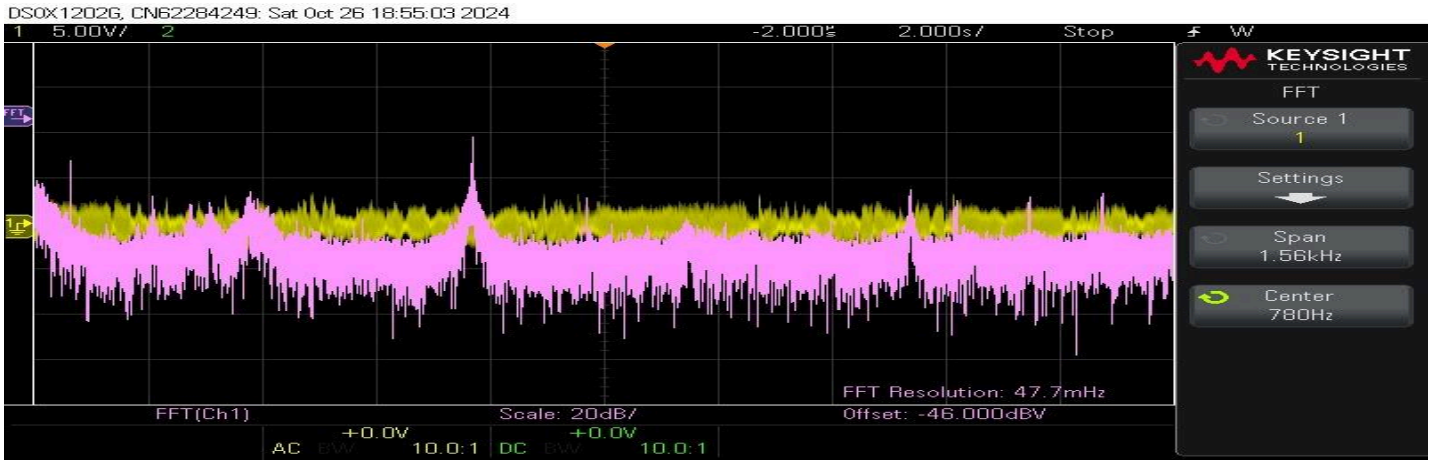
450Hz



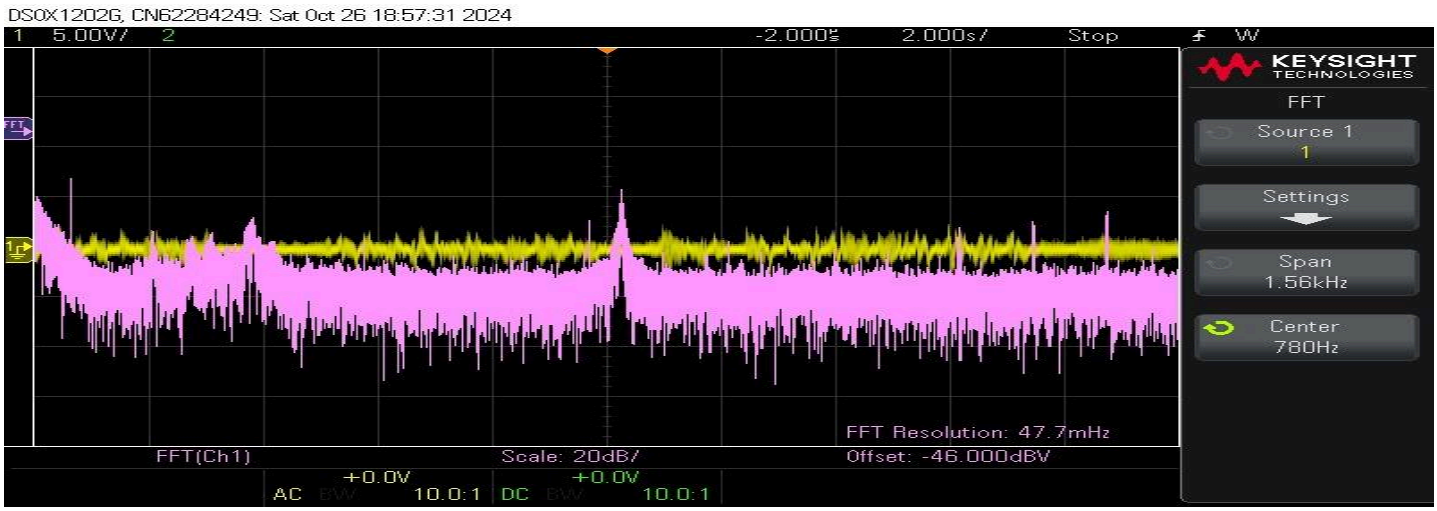
470Hz



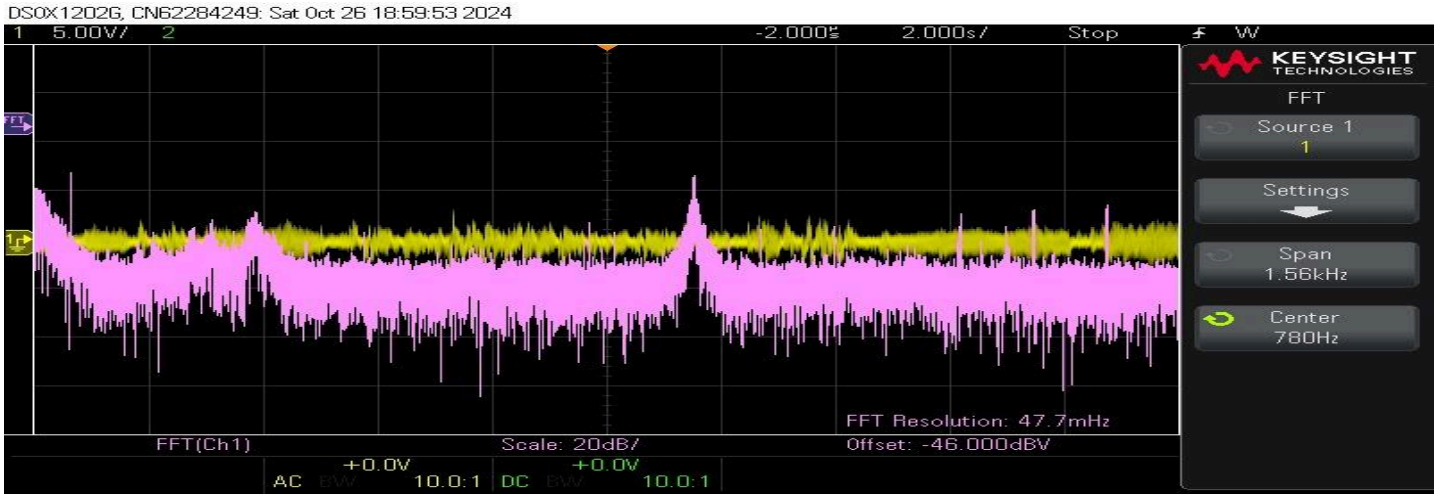
500Hz



600Hz



700Hz



900Hz

1000Hz

1100Hz

1200Hz

Results and Conclusion:

1. From the graphs, we see that the resonance peak attuned to the noise frequency generated by external source is traversing in the FFT with changing the external frequency, from which we can conclude that external acoustic noise does affect the interference pattern in a specific manner.
2. For the sensitivity, the lowest frequency we were able to measure was 410 Hz. However, we can see that there is a difference in the graphs of 410 and 430 Hz (and 430-450 Hz and so on), so this can lead to the conclusion that the fringe pattern is sensitive to frequency changes as low as 20Hz.

Difficulties:

1. Setting up the interferometer: We changed our set-up from Mach Zehnder interferometer (MZI) to Michelson interferometer because the fringe pattern was not very stable with MZI and the arrangement itself was difficult to set-up perfectly especially with the existing environment.
2. Getting the graphs from DSO: We tried various modes and different types of graphs on the DSO until we got the right one which reflected changes in the fringe pattern in the form of peaks in frequency of the graph.

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