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Building a Lock-in Amplifier for an Ionization Experiment¹ MA-SON RUBY, Union University, STEFAN ZIGO, BRANDIN DAVIS, BRETT DE-PAOLA, CARLOS TRALLERO-HERRERO², Kansas State University — A lock-in amplifier is a device used to recover information from an electric signal with a high signal-to-noise ratio. It achieves this using phase sensitive detection in which a periodic signal is multiplied by a reference signal with the same frequency. The result is then integrated, resulting in a DC signal proportional to the original signal without any influence from the noise. Our research focused on implementing this technique in an ionization experiment utilizing time-of-flight mass spectrometry so that we could dramatically increase the range of our detector. The experiment required that we keep the waveform of the signal intact which is usually impossible with a lock-in amplifier since the output is a DC signal. We developed a method in which the phase of the reference was incrementally changed, causing the output of the lock-in to change also. Taking the derivative of the output reproduced the original waveform. Thus, we were able to show that it is possible to retrieve temporal information from a lock-in amplifier, potentially allowing us to use it for this experiment as well as any other requiring a large detection range.

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