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**Mentor:** Dr. Chris Waltham (Science One Physics Professor)

**Title:** Modelling the Effect of Temperature on Resonant Frequencies with a Standard Trumpet

### Summary/Abstract:

The objective was to experimentally confirm a relationship between increased temperature and frequency output of brass trumpets. It was hypothesised that the resonance frequencies of a trumpet will experience a shift upwards when exposed to temperatures higher than the standard ambient value of 25 °C, due to the increasing kinetic energy of air molecules accelerating the velocity of the sound waves. To measure this, a full range of frequencies, known as pure white noise, was projected through the bell of a silver-plated brass trumpet. The trumpet was then exposed to temperatures significantly above and below the standard ambient value. Using a frequency spectrum reader (Spectrum Lab), the range of frequencies was first recorded at 5°C. Data collection was paused, at which point the trumpet temperature was significantly increased to about 32°C, then unpaused again. Frequency pattern shifts between the two graphs were then analyzed. It is accepted in the musical community that keeping an instrument's output in tune while performing in non-ambient temperatures is much more difficult. Since the speed of sound is heavily dependent on heat, instruments are calibrated to play set frequencies at approximately room temperature. The data show consistent increases in resonance frequencies as air temperature rises, supporting the hypothesis that higher temperature results in the sharpness of trumpet pitches.

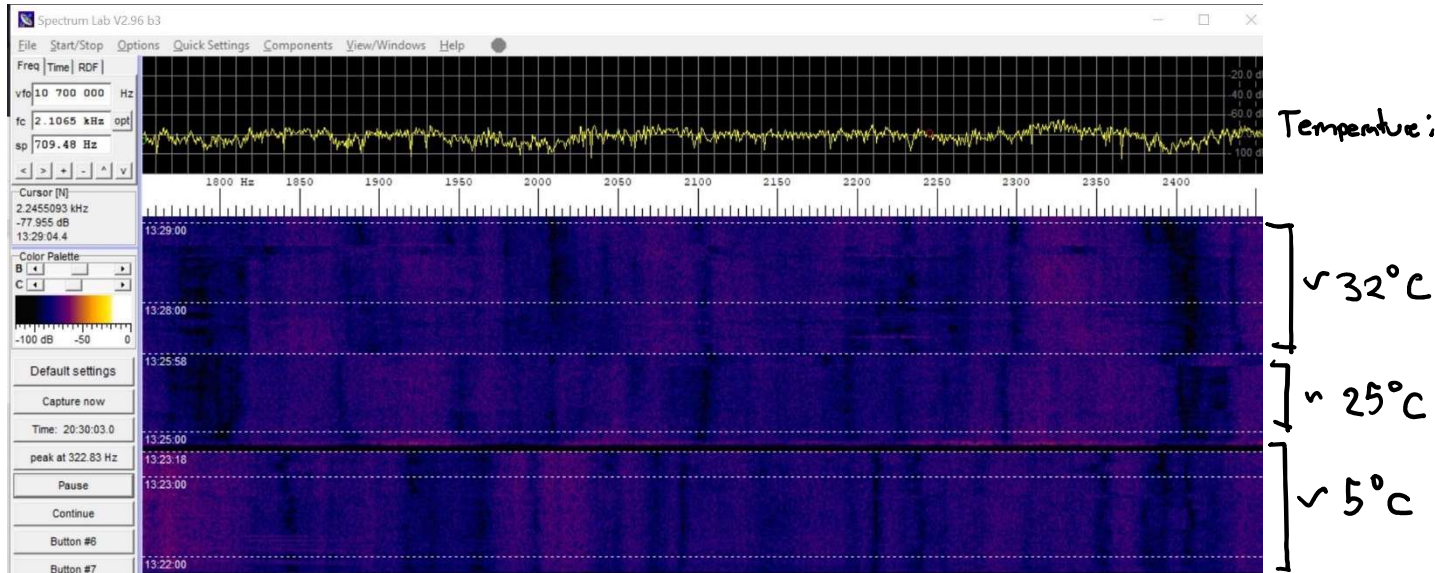


Fig 1. An above screen capture of Spectrum Lab. The data shows a shift to the right (sharper) in trumpet white noise resonance frequency concentrations each time temperature is increased.

Axes: Vertical axis of time (bottom to top, past to present) & Horizontal axis of frequency (increasing from left to right)