Acoustic Focusing With Gases

Schwickert, Mikolas (School: ASU Prep Digital)

Sound waves are all around us, but we never think about how they can be controlled or focused like light can be. My project explores if sound waves can be bent or concentrated using gases with different densities, like helium, carbon dioxide, and air to make a sound lens. Of importance is to understand how sound behaves in different environments which could lead to new ways to manipulate sound like improving audio systems, designing better acoustic equipment, shielding or enhancing sound, and even for creating more precise ultrasound technologies, for example for medical applications. If the sound waves pass the air-gas interface at slanted angles, where the gas has different molecules than air, for example in a balloon, then they will be able to bend and focus or defocus in specific directions. The speed of sound changes inside the balloon where different molecules have different mobilities and mean velocities. By testing different gases, gas properties would influence the behavior of the sound waves. This technique could be used to focus or disperse sound in controlled ways. It was found that the effect of sound refraction is strongly dependent on frequency and on the sound and the kind of gas. Carbon dioxide shows a focusing effect between 1.2-6 kHz, while helium tends to disperse sound, particularly below 3 kHz, which could be due to its index of refraction $n < 1$.

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