

## The Truth About Subwoofers

### How the Brain Perceives Sound Location

One of the more common concerns we hear, is that because the bass in our systems is being reproduced by a mono subwoofer, the user fears that they may be able to perceive it as a separate, locatable source. This is actually not the case and although this is a common misconception, in correctly designed 2.1 or 5.1 systems, using proper bass-management, it should not be an issue at all.

To understand why this is the case, we must first understand how our brains process location cues from our ears. Above approximately 700 Hz (depends on the size of your head), your brain uses Interaural Level Difference (ILD) as the primary factor in determining the directional location of a sound (slightly over simplified explanation). ILD is the difference in level of a sound, between your two ears.

Below approximately 700 Hz your brain begins to rely on the Interaural Time Difference (ITD) between your ears, also known as – phase shift, to determine the directional location of a sound. This works very well until the wavelengths get very long, the source becomes omni-directional, such as a subwoofer, which radiates energy spherically in its pass band, and you are in an enclosed space. In an enclosed space, such as a studio, with a source that is radiating spherically (again, such as a subwoofer), the ITD will be close to zero. This is because energy from the source is arriving at the listener from many paths, with many overlapping time differences and your brain will not be able to derive the primary location cues from your ears. Therefore your directional acuity at these low frequencies will be near zero. However, you will have very high directional acuity at higher frequencies and because your directional cues are coming from the SATs, which typically are playing the harmonics of the LF fundamentals, this is where your brain believes the sound is coming from. Provided there is no audible distortion or sonic artifacts at higher frequencies (port noise etc.), and the sound emanating from the subwoofer is limited to below approximately 100 Hz, it will be impossible for the listener to identify the location of the subwoofer in a studio.