Note that for an acoustic plane wave propagating in ***free air*** (*e.g.* the great outdoors), $SPL = L_p$ and $SIL = L_I$ are essentially the same numerical values in *dB*, and are typically are within 0.1 *dB* of each other across the frequency spectrum of human hearing. However, *e.g.* inside an auditorium (or, more generally, in any ***confined*** space), due to sound reflection from the walls/ceiling/floor (creating multiple sound waves/standing waves), $SPL = L_p$ and $SIL = L_I$ will ***not*** necessarily be the same! {We will discuss this in more detail in subsequent lecture(s)}

Note also that most microphones – one (of many) kinds of sound transducers – are such that they are sensitive/respond to (over)-pressure. Hence, technically speaking, such microphones measure/determine the Sound Pressure Level, $SPL = L_p$ (not Sound Intensity Level, $SIL = L_I$).

Apparent Loudness Level: Phons

The perceived response of {average} human hearing to ***constant*** loudness levels (*aka* sound intensity levels) $SIL = L_I$ is ***not*** independent of frequency. The response of the human ear for very low (< 20 *Hz*) and very high frequencies (> 20 *KHz*) is increasingly poor. Note that the open-closed ¼-λ resonances associated with the ear canal affect our loudness level response.

Because human hearing is not flat with frequency, the perceived, or ***apparent*** loudness of a sound depends on frequency, and also on the actual intensity I (in $Watts/m^2$), or equivalently, the actual loudness L_I (in *dB*) {or sound pressure level L_P = SPL (in *dB*) of the sound.

In 1933, Fletcher and Munson obtained average values of the ***apparent*** loudness of sounds for human hearing as a function of these variables. The unit of ***apparent*** loudness L_{app} is the ***Phon***, defined as the value of the ***SPL*** that has ***constant apparent loudness*** for (average) human hearing. The figure below shows the {ISO 226:2003 revised} Fletcher-Munson curves – contours of constant ***apparent*** loudness $L_{app}(f)$ *vs.* frequency, *f*.