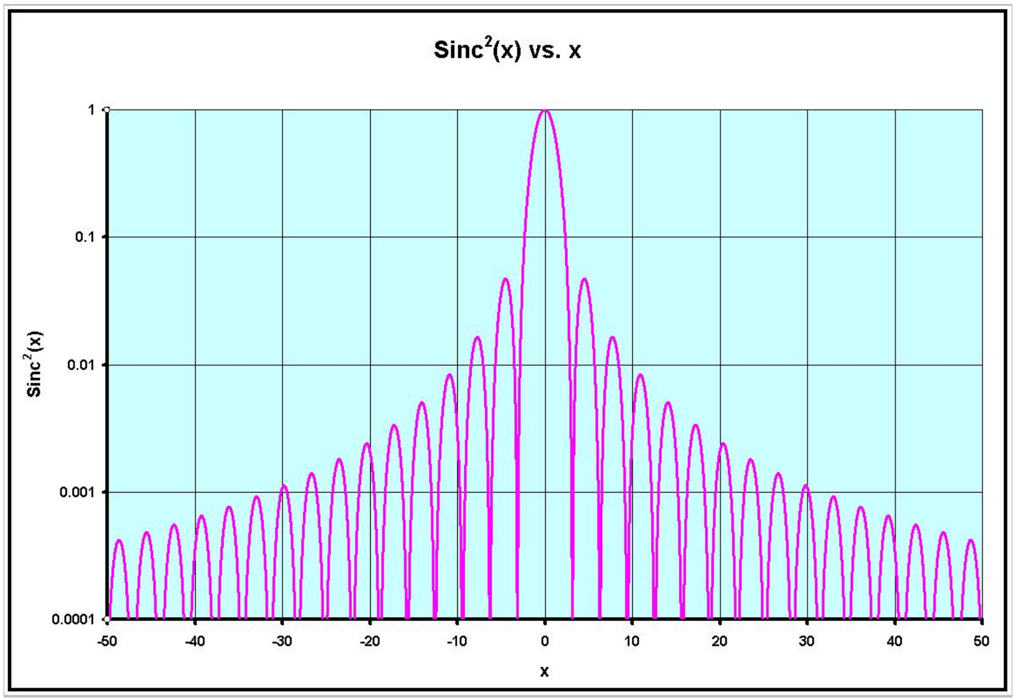
The Sinc² function – $\text{Sinc}^2(x)$ *vs*. *x*, where $x = \frac{1}{2}\delta_{\max} = (\pi a \sin\theta/\lambda)$, relevant for diffraction of sound (or light) through a narrow slit/aperture of lateral width *a* is shown in the figure below, as a ***semi-log*** plot. The global maximum of the intensity/power is in the central lobe, near $|x| \sim 0$.



Diffraction minima occur when $x = \frac{1}{2}\delta_{\max} = (\pi a \sin\theta/\lambda) = \pm\pi, \pm 2\pi, \pm 3\pi, \ldots = \pm m\pi$, $m = 1, 2, 3, \ldots$.

Diffraction Through a Circular Aperture of Radius, *R*:

A more realistic situation for diffraction of sound is that of diffraction through a circular aperture. Diffraction occurs in ***all*** sound-generating transducers, such as loudspeakers. For a circular loudspeaker of radius *R* (*n.b.* also mounted on an infinite baffle) the angular intensity distribution $I(\theta)$ resulting from the sound diffracting from the aperture of the loudspeaker is given by:

$$I(\theta) = I_o \left[\frac{2J_1(\rho)}{\rho}\right]^2 = I_o \left[\frac{2J_1(kR\sin\theta)}{kR\sin\theta}\right]^2$$

where θ is the polar angle from the axis of the loudspeaker, $\rho \equiv kR\sin\theta$ and $J_1(\rho)$ is the ordinary Bessel function of order 1. Bessel functions frequently arise in situations where circular/cylindrical symmetry is involved. The Bessel function of order *n*, $J_n(x)$ can be expressed as a power series expansion in *x*:

$$J_n(x) = \frac{x^n}{2^n\Gamma(n+1)}\left\{1 - \frac{x^2}{2(2n+2)} + \frac{x^4}{2\bullet 4(2n+2)(2n+4)} - \ldots\right\} = \sum_{k=0}^{\infty} \frac{(-1)^k (x/2)^{n+2k}}{k!\,\Gamma(n+k+1)}$$