The characteristic, or so-called eigen-frequencies, eigen-wavelengths, eigen-energy densities associated with 1-D axial, 2-D transverse and fully 3-D oblique modes of acoustic standing waves in a room can be "generically" written as:

$$f_{lmn} = \omega_{lmn} / 2\pi = v k_{lmn} / 2\pi = v / \lambda_{lmn} = \tfrac{1}{2} v \sqrt{\left(l/L_x\right)^2 + \left(m/L_y\right)^2 + \left(n/L_z\right)^2}$$

$$\lambda_{lmn} = 2\pi / k_{lmn} = 2 \Big/ \sqrt{\left(l/L_x\right)^2 + \left(m/L_y\right)^2 + \left(n/L_z\right)^2}$$

$$w_{lmn} = \tfrac{1}{4} \rho_o \omega_{lmn}^2 A_{lmn}^2 = \pi^2 \rho_o f_{lmn}^2 A_{lmn}^2 = \tfrac{1}{4} \pi^2 v^2 \rho_o A_{lmn}^2 \left[\left(l/L_x\right)^2 + \left(m/L_y\right)^2 + \left(n/L_z\right)^2 \right]$$

$$l, m, n = 0, 1, 2, 3, 4, 5, ...$$

The 1-D axial modes have the lowest frequency and/or energy; the {1,0,0} axial mode is the lowest, the next lowest is the {0,1,0} axial mode, the next lowest is the {0,0,1} axial mode.

If the room is <u>cubical</u> in shape, *i.e.* {$L_x = L_y = L_z$}, then ***<u>degeneracies</u>*** (*i.e.* standing waves having the same energy/mode} in various of the standing wave modes will exist, the first few of which are summarized in the table below:

[*l,m,n*] Mode	Degeneracy		Mode Type
[100,010,001]	3		1-D Axial
[101,011,110]	3		2-D Transverse
[111]	1		3-D Oblique
[200,020,002]	3		1-D Axial
[201,210,021,012,102,120]	6		2-D Transverse
[211,121,112]	3		3-D Oblique

Thus, the degeneracies associated with a cubical-shaped room imply that a cubical room will be more problematic in terms of room resonances and acoustic feedback than for a rectangular-shaped room, where {$L_x \neq L_y \neq L_z$}. This can be seen from the so-called density of states for 3-D standing waves in a cubical vs. rectangular room, as shown in the figure below for two equal volume rooms, one cubical, the other rectangular, the latter with *L*:*W*:*H* ratio 3:2:1: