Asteroseismology Quick Notes

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Brunt Vaisala Frequency: Determines the buoyancy.

$$N^2 = g\left(\frac{1}{\Gamma_1 P}\frac{\mathrm{d}P}{\mathrm{d}r} - \frac{1}{\rho}\frac{\mathrm{d}\rho}{\mathrm{d}r}\right) \tag{1}$$

Or for a fully-ionised ideal gas:

$$N^2 \approxeq \frac{g^2\rho}{P}(\boldsymbol{\nabla}_{\mathrm{ad}} - \boldsymbol{\nabla} + \boldsymbol{\nabla}_\mu) \tag{2}$$

$N^2 > 0$ means you get oscillations about the equilibrium, otherwise you get convective instabilities.

Convective regions: Gravity waves *cannot* propagate in convective regions. Recall that $M > 1.2\,\mathrm{M}_\odot$ stars have convective cores (and this covers the entire mass range for this project). Larger stars will have larger convective cores.

Lamb Frequency: This seems to also be referred to as the characteristic acoustic frequency.

$$S_l^2 = \frac{l(l+1)c_s^2}{r^2} \tag{3}$$

p **modes and** g **modes:** p modes have high frequencies above both N and S_l, whilst g modes have low frequencies below both N and S_l. Any intervening regions have waves exponentially increasing/decreasing as a function of r.

Degrees and order: The degree is l, the azimuthal order is m and the radial order is n.

Period spacing: The periods of low-order high-degree g modes ($N^2 \gg \omega^2$) are given by

$$P_k = \frac{\pi^2}{\sqrt{l(l+1)}\int_{x_0}^{1}\frac{|N|}{x}\,\mathrm{d}x}(2k + n_e) \tag{4}$$