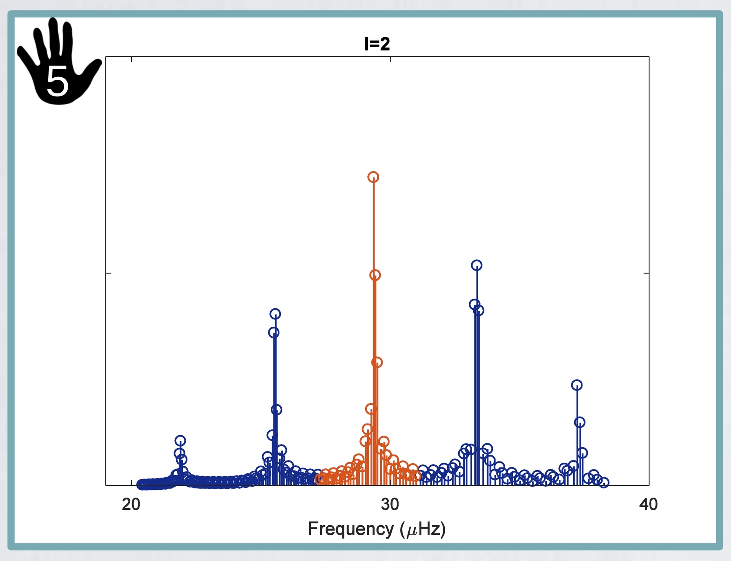
SOUNDS OF THE STARS

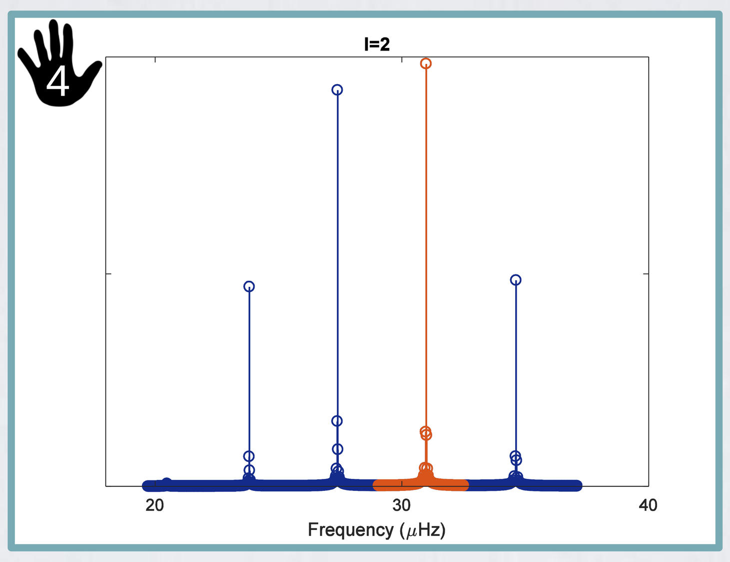
Asteroseismology allows us to 'listen' to the sounds of the stars. Turbulence in the outer layers of cool stars generates sound waves which become trapped within the star. The sound waves periodically compress the star, making the surface brightness change. The changes in brightness are observed and allow the resonant frequencies to be determined. Standing waves can form on the surface of the star (imagine waves on a string around the equator) which gives rise to different 'spherical degrees' (l).

This poster explores how the sounds of a solar mass star change during its evolution. The stem plots in blue and orange boxes show the frequency spectrum of the star – the frequencies detected and their relative strengths.

Mode Mixing

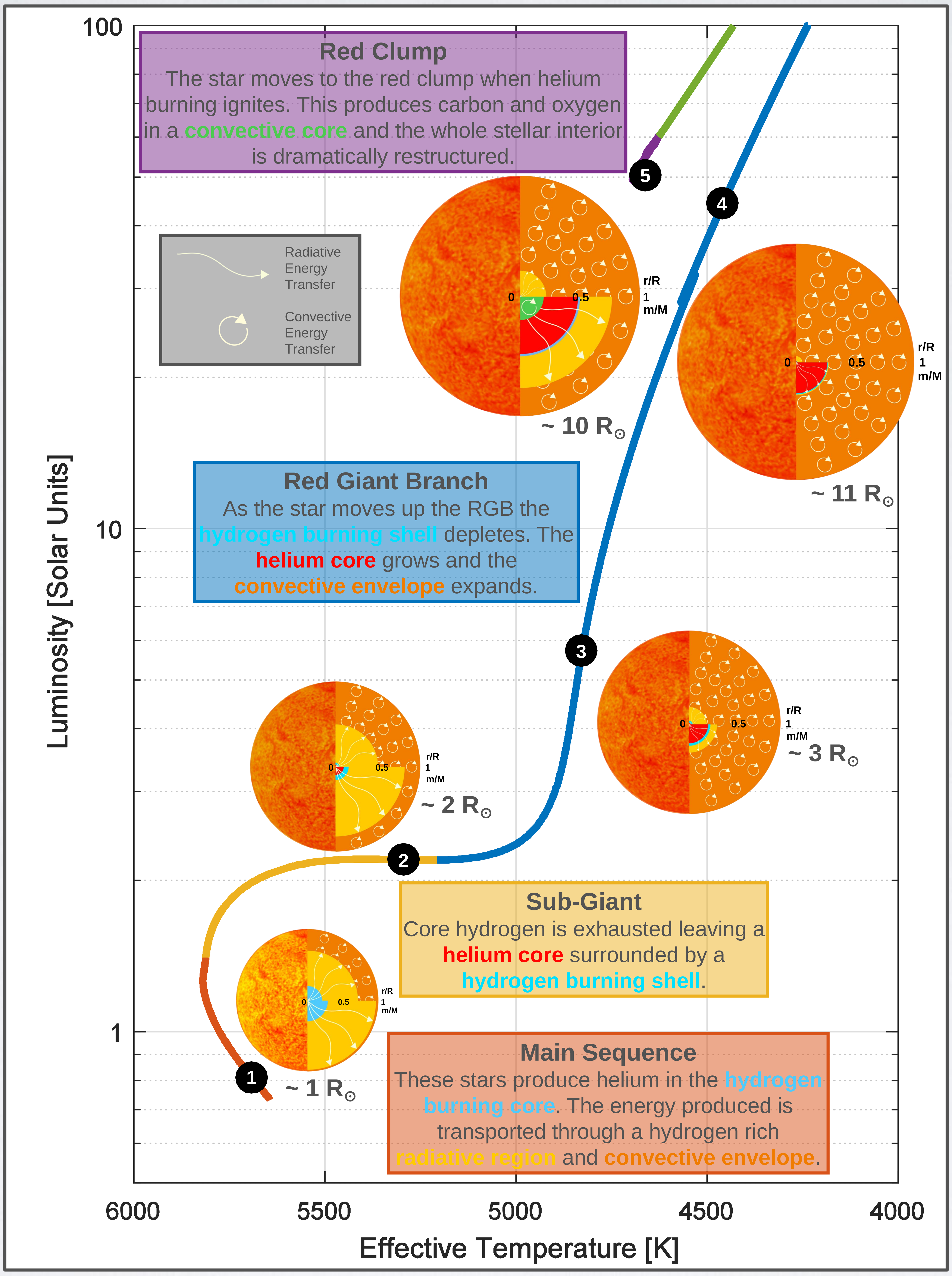
In main sequence stars, frequency observations are dominated by pressure or *p-modes* with simple 'comb like' spectra. As the star evolves gravity or *g-modes* interact with the (non-radial) p-modes creating modes of 'mixed character'. This results in clusters of mixed modes around each p-mode peak. The spacing of the mixed modes gives information about the near-core structure of the star, which is useful in cases where the surface properties are similar – e.g. for distinguishing red giants from red clump stars.

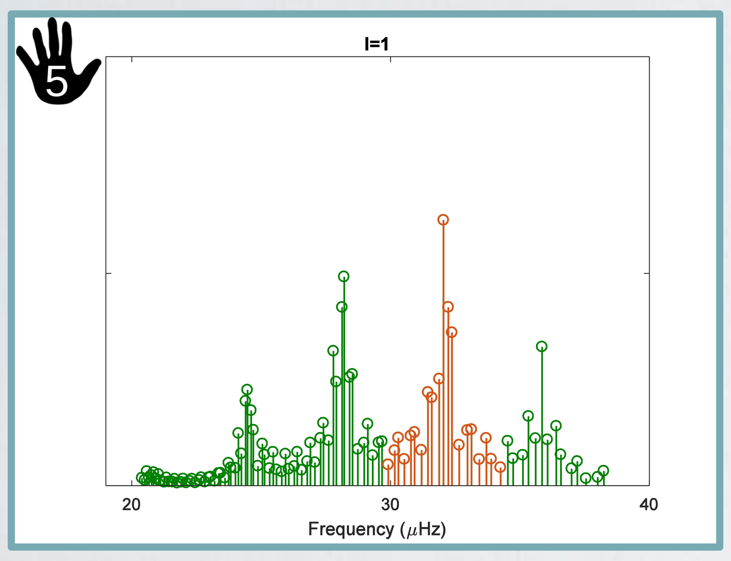


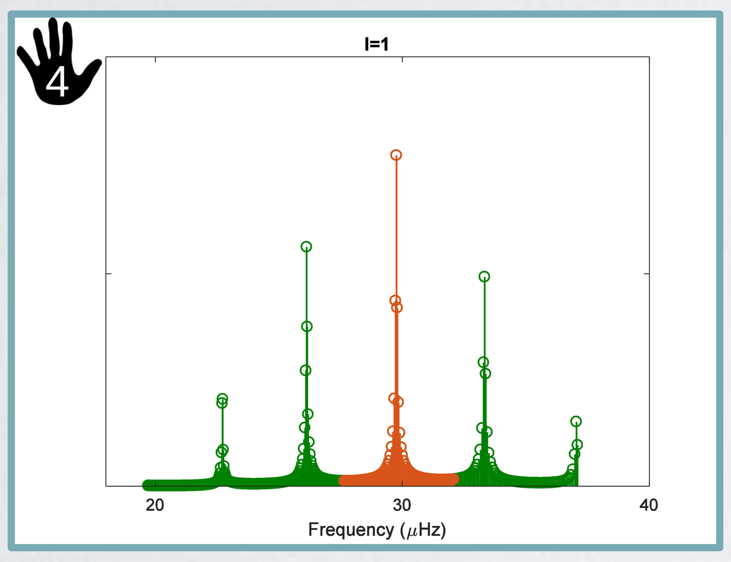


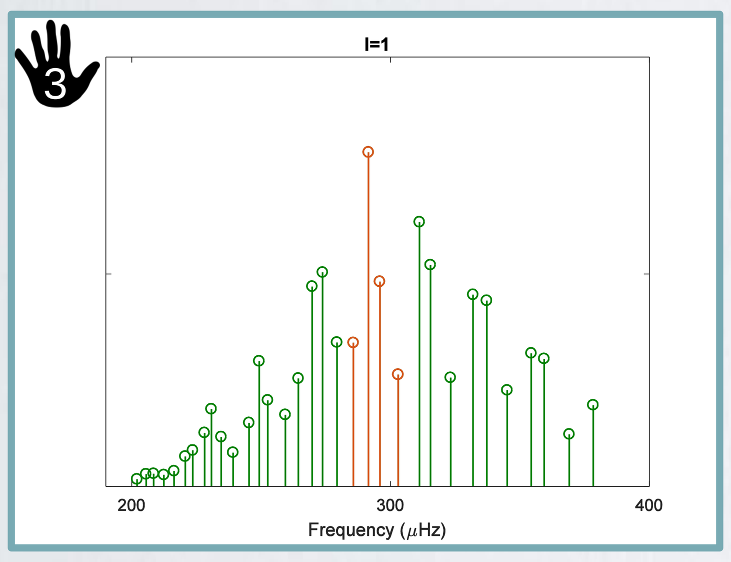
HR Diagram

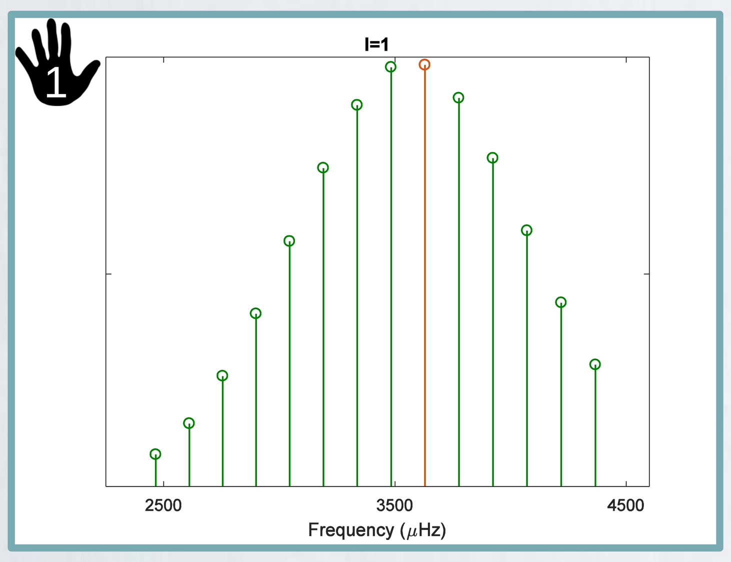
The large graph shows the star's evolutionary track. Initially on the ***main sequence***, the star evolves to become a ***sub-giant***, then a ***red giant*** before joining the ***red clump*** and eventually the ***asymptotic giant branch***.





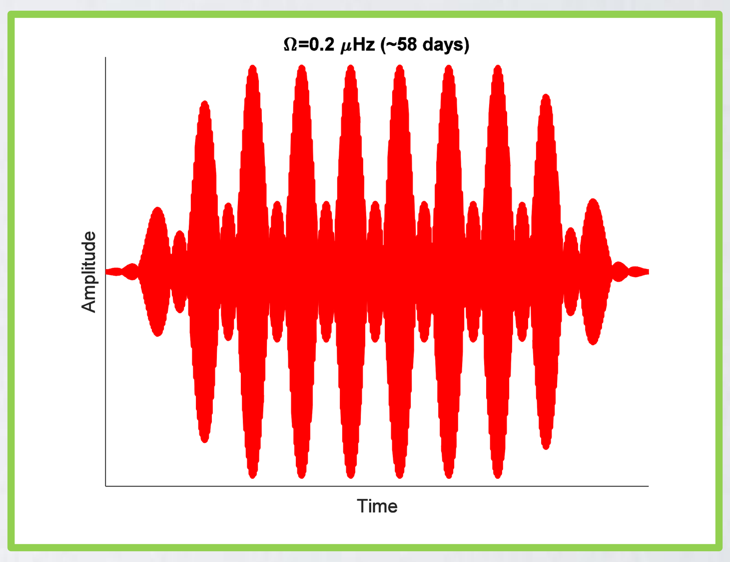


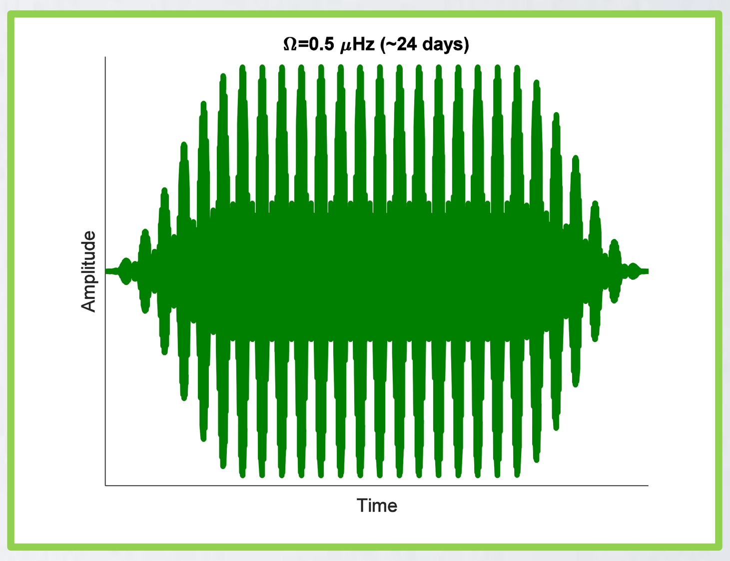


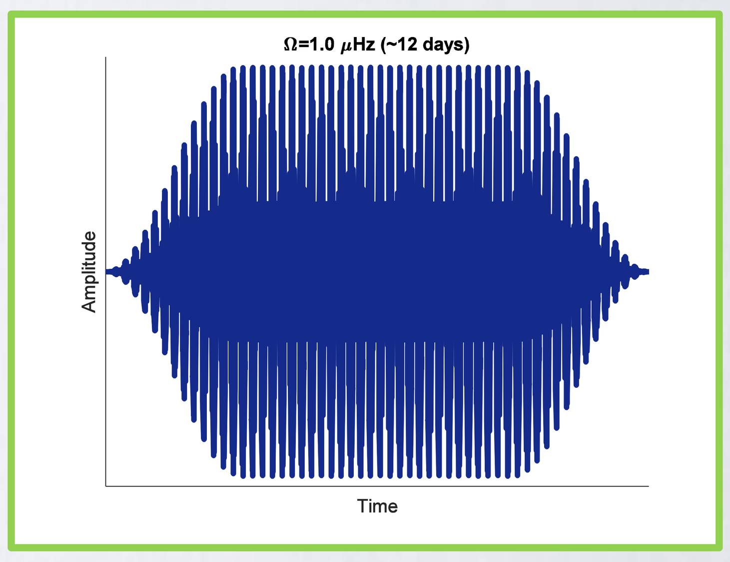


Rotation

Imagine a non-rotating star, producing a constant tone. Introducing rotation breaks the spherical symmetry of the system, which 'splits' the frequency peak. This means the star produces a set of very similar frequencies. Interference between the frequencies causes beating in the sound. The period of the beating depends on the rate of rotation, decreasing as the star spins faster. The sound is generated by continuously increasing the rotation rate and the images below show the interference pattern at three points in this process.

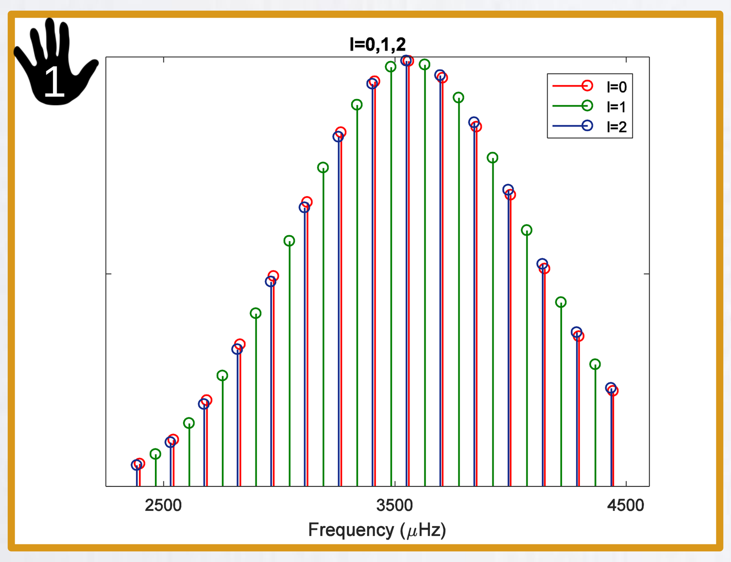


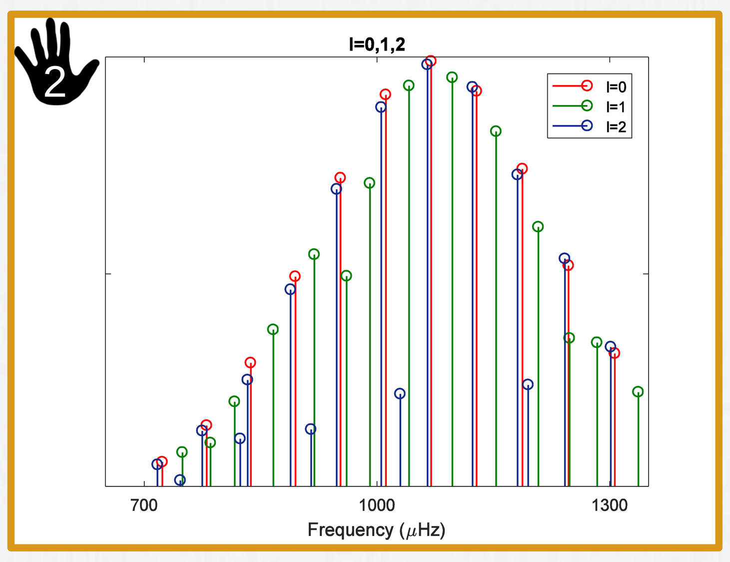


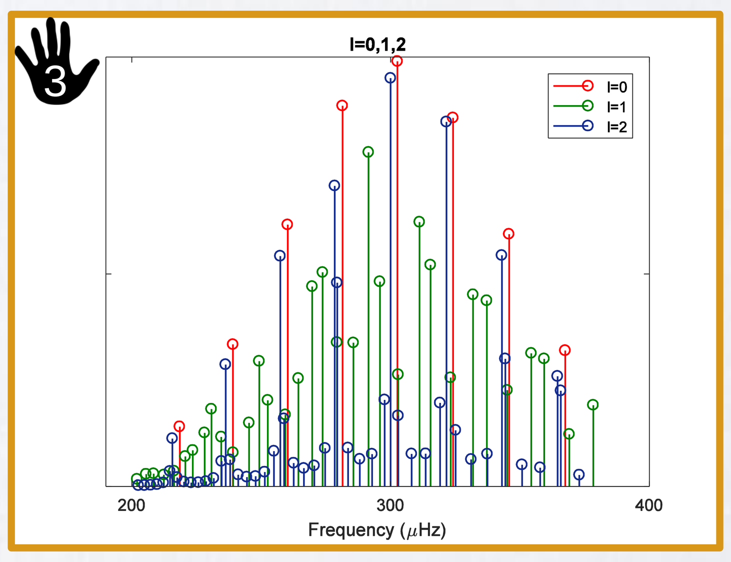


Radius

As the star evolves off the main sequence, its radius greatly increases. This means that the resonant frequency decreases – the pitch of the sound is lower.







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