# First Year Report: Seismological observations of the inner core

Jessica Irving
Trinity College

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# 1 Abstract

An abstract summary of my material. I would like to use this section to lure any potential readers into looking at this exciting treatise on my research topic. I've also been told that in the abstract it's best not to use *bold*, *italics* , type underlined text or anything else that's too fancy. So maybe I shouldn't have. I've left text I wrote in the rest of this - but that doesn't mean it's worth reading.

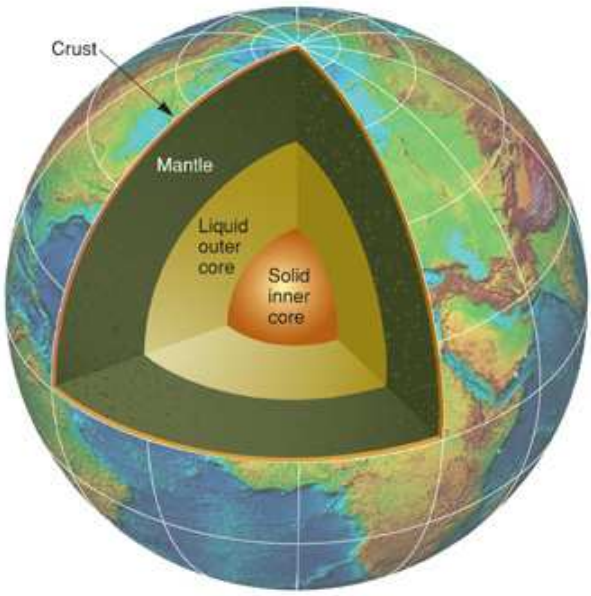


Figure 1: The basic structure of the Earth.

# 2 Introduction

The Earth has lots of layers - have a look at Figure 1 to see what they might be. And be aware that this figure is not to scale - though it is pretty.

## 2.1 Making lists

Should you need to make lists you can:

1. list your
2. points by numbering them
3. without having to change all the numbers if
4. you add a new point in the middle or
5. you rearrange them.

- On the other hand you may
- prefer to just have your
- objects without numbers
- and just put bullet points by them

Table 1: Groups of inner core modes that couple with the seven modes of interest in the Woodhouse model.

| Mode Studied | Couples With |
|---|---|
| ${}_2S_0$ | ${}_7S_2$ ${}_6S_2$ ${}_4S_6$ |
| ${}_{11}S_1$ | ${}_{10}S_1$ ${}_9S_3$ ${}_7S_5$ |
| ${}_4S_0$ | ${}_{10}S_2$ ${}_{11}S_2$ |

### 2.2 Typing as vertabim

The `\verb` command will print the text exactly as you type it, without the pretty LaTeXformatting. [1].

#### 2.2.1 Some more text

However, for waves of very low frequencies and long wavelengths, effects like gravitation, ellipticity and rotation of the Earth become important and the approximations used in the ray theory are invalidated. The best way to model these seismic waves is using normal modes. Normal modes are free oscillations of the whole Earth. The vertical and horizontal motion they cause at the Earth's surface can be detected using a seismograph. for asummary of recent research see Song's review Song (1997).

## 3 Theory

### 3.1 Coupling of normal modes

The Earth is not a perfect sphere, but an oblate spheroid - the radius of the Earth at the poles is 6357km and 6378km at the equator. The asphericity and rotation of the Earth remove the degeneracy of the normal modes. The mode is now a set of $(2l + 1)$ singlets.

$$\text{misfit} = \frac{|z_d - z_s|^2}{z_d^2} \tag{1}$$

where $z_d$ is the complex value of the data trace and $z_s$ is the complex value of the synthetic seismogram trace.

## 4 Conclusions

It has been shown that when inner core anisotropy is taken into account the difference between the self and full coupling approximation can be large. This is due to the coupling of inner core modes with degree zero, two or four difference in order.

## References

A. Deuss and J. Woodhouse. Theoretical free-oscillations spectra: the importance of wide band coupling. *Geophysics Journal International*, 103:783, 2001.

X. Song. Anisotropy of the earth's inner core. In *Reviews of Geophysics*, volume 35, pages 297 – 313. American Geophysical Union, 1997.

[1] a short comment added hear will appear in a footnote to this page

# A Appendix - Theory for normal modes

The displacement of the Earth, $\mathbf{s}$, can be represented by:

$$\mathbf{H}\mathbf{s} + \mathbf{W}\partial_t\mathbf{s} + \mathbf{P}\partial_t^2\mathbf{s} = \mathbf{S} \tag{2}$$

Where $\mathbf{H}$ represents the potential energy operator, $\mathbf{W}$ represents the Coriolis operator, $\mathbf{P}$ is the kinetic energy operator and $\mathbf{S}$ represents the excitation caused by the earthquake source. The solution to this equation will be of the form $s(x,t) = s(x)e^{\imath\omega t}$ where $\omega$ is the radial frequency of the normal mode.