

# MPhys Final Project Report

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My Abstract

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## 1 Introduction

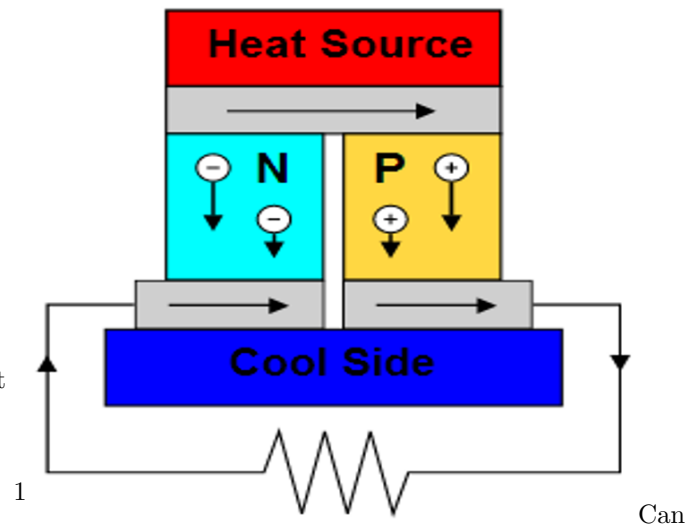
1. Interest and importance of thermoelectricity.
2. Choose material (Si-Ge).
3. Calculate ZT.
4. Check calculations consistent with Chen.
5. Extend calculations (EMA, specularity...)
6. Suggest new research.

### 1.1 Thermoelectric History

History of thermoelectric effect. Who found what when.

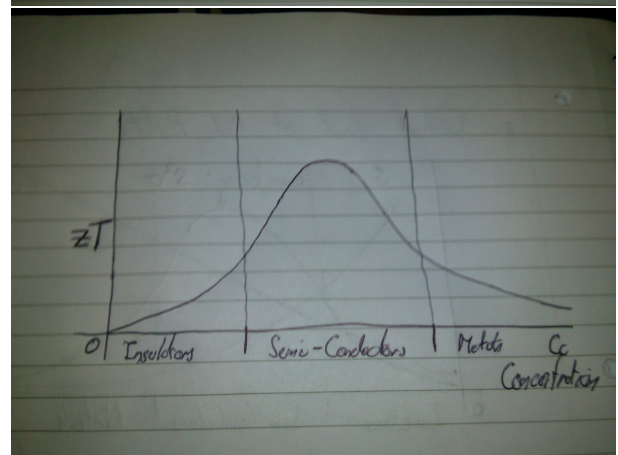
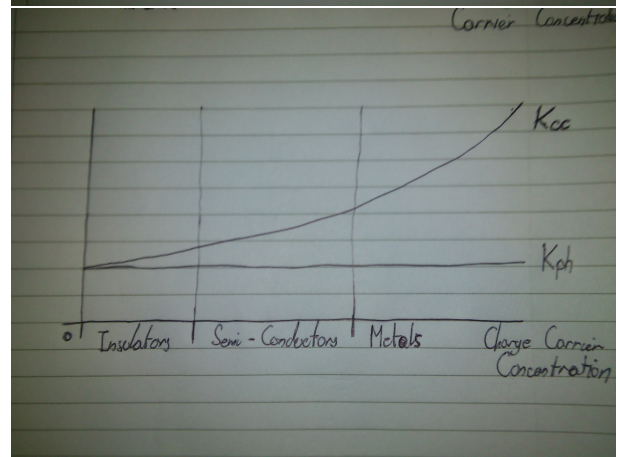
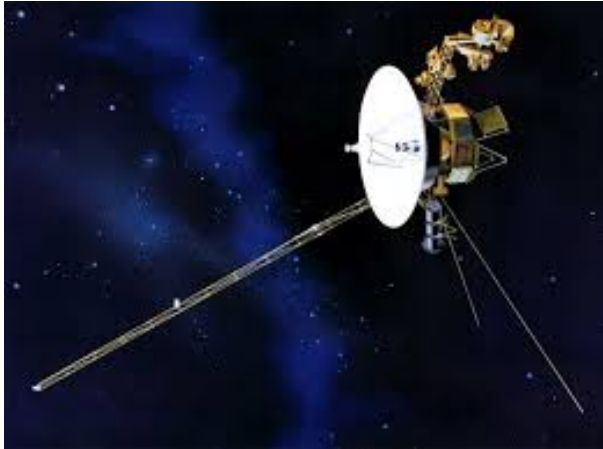
### 1.2 Thermoelectric Generators

A schematic generator:



use generators using thermoelectric effect in places where maintenance is difficult and total power requirements low, for example in space.

A common RTG (radioisotope thermoelectric generator) application is spacecraft power supply. RTGs were used for probes that traveled far from the Sun where the radiation was too weak for photo-voltaic solar panels. They were used on the Voyager spacecraft:

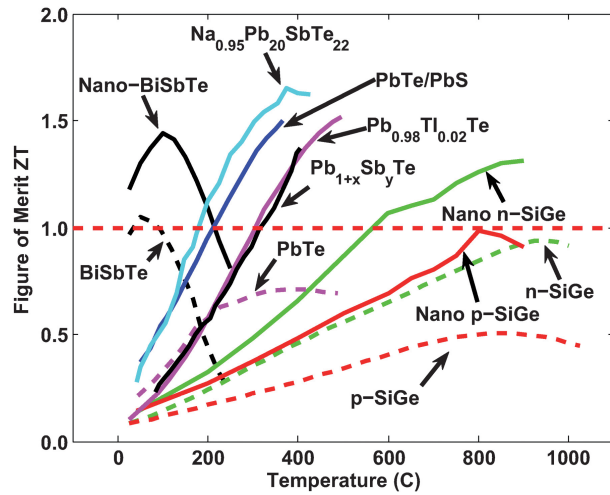


### 1.3 Thermoelectric Efficiency

Thermoelectric efficiency - relationship with Carnot efficiency. Definition of  $ZT$

### 1.4 Thermoelectric Materials

Required properties. Temperature range. Need models to guide manufacturing because making them is expensive. Reports of other groups (Chen). Silicon-germanium looks interesting. Nano composites perform better than alloys.



## 2.2 Maximizing Power Factor

## 2.3 Minimizing KT

# 2 Modelling ZT

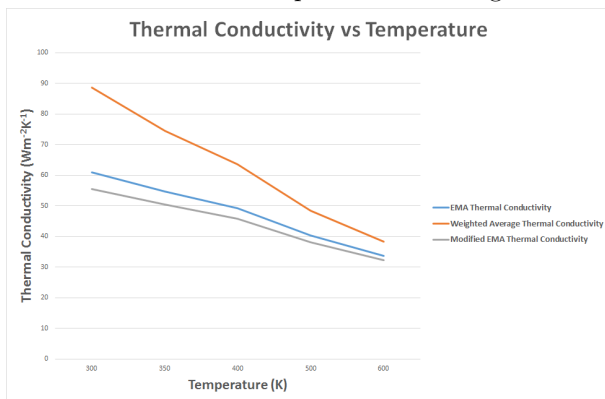
## 2.1 Components of ZT

### 2.1.1 Power Factor

Seebeck effect. Electrical conductivity. Electron mean free path. Looks like crystal to electrons,

### 2.1.2 Thermal Conductivity

Contributions to thermal conductivity. Weideman Franz law. Electrob thermal conductivity related to electrical conductivity. Leaves only phonon component to minimize. Want lots of phonon scattering



## References

- [1] *Reference Source*