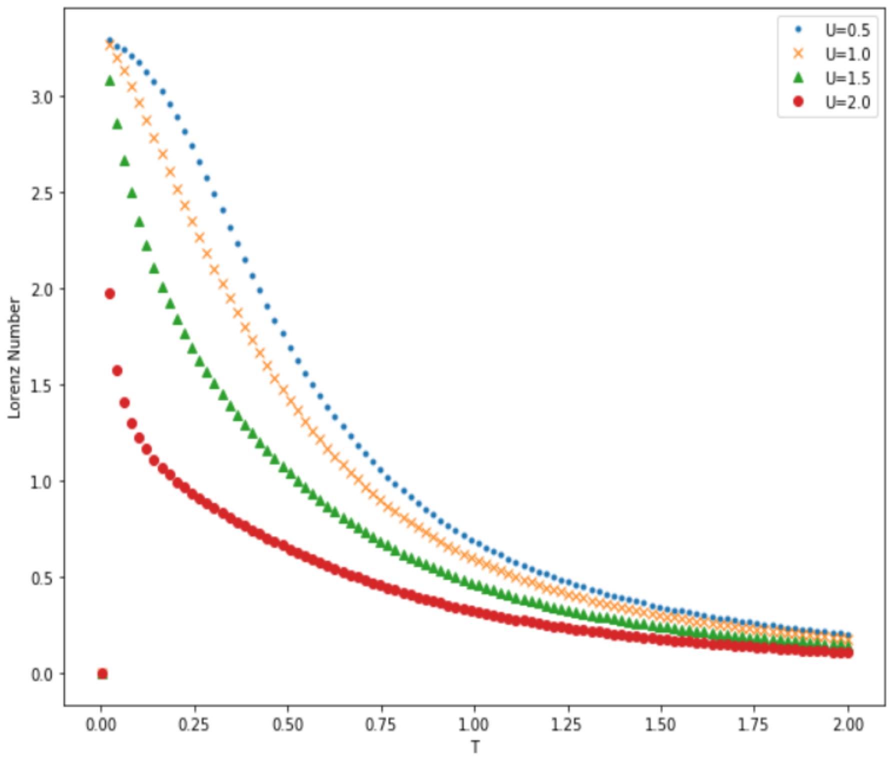
# Homework 7

Logan Xu

April 2020

## 1 Problem 1




Unit for the thermal conductivity is

$$\frac{(m/s)m(m^2kg)}{s^2Km^3} = \frac{kg}{s^3K}. \tag{1}$$

Unit for the electrical conductivity is

$$\frac{C^2m}{kgm/s(m^3)} = \frac{C^2s}{kgm^3}. \tag{2}$$

Thus the Lorenz number has the unit

$$\frac{kg^2m^3}{s^3KC^2s}\frac{1}{K} = \boxed{\frac{kg^2m^3}{s^4K^2C^2}}. \tag{3}$$

At lower values of $T$, the thermal conductivity is much larger than the electrical conductivity, resulting in a larger Lorenz number.

# 2 Problem 2

Given

$$S = \frac{k_B}{|e|T} \frac{L_{12}}{L_{11}}, \tag{4}$$

and

$$L_{12} = const \int d\epsilon \rho(\epsilon) \phi(\epsilon) \int d\omega A^2(\epsilon, \omega)(-\frac{\partial f}{\partial \omega})(\omega). \tag{5}$$

We know that at half-filling for a spinless FK model, the density of states function is

$$\frac{\sqrt{4 - \epsilon^2}}{2\pi}, \tag{6}$$

which is even. This makes the spectral function even. The $\phi(\epsilon)$ is

$$\frac{4 - \epsilon^2}{3}, \tag{7}$$

which is even. The derivative of the fermi-dirac distribution is proportional to $\cosh \omega\beta$, which is even. All these even functions multiplied by an odd function $\omega$ gives rise to an odd function, which makes the integral $\boxed{0}$ if we integrate over all $\omega$.